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SYLLABUS

for

M.Sc. Bioinformatics (Integrated) Programme

(2023-2024 ONWARDS)

Outcome Based Education (OBE)

DEPARTMENT OF

BIOTECHNOLOGY AND BIOINFORMATICS

BISHOP HEBER COLLEGE (Autonomous)

(Affiliated to Bharathiodasan University)

(Nationally Reaccredited with A Grade by NAAC with CGPA of 3.58 out of 4)

Recognized by UGC as 'College of Excellence'

Tiruchirappalli – 620 017

DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

M. Sc., Bioinformatics (Integrated)

VISION AND MISSION

OUTCOME BASED EDUCATION

VISION

The Department seeks to create holistic development through teaching, research and extension activities to solve the biological issues through computational approach.

MISSION

The Department of Biotechnology & Bioinformatics aims,

- Providing technical education and research by imparting biological and computational knowledge through updated curriculum
- Enable in developing algorithms for solving biological problems
- Inculcate values to serve the society with professional ethics

OUTCOME BASED EDUCATION

M. Sc., Bioinformatics (Integrated)

Programme Outcomes (POs):

On successful completion of the Integrated Programme, graduand will exhibit the following abilities in the respective domains

Knowledge

PO1. Comprehend knowledge of advanced concepts, theories, scientific phenomena, technology and relating to living organisms

PO2. Apply the knowledge of scientific concepts for solving problems related to corporate world and environmental world

PO3. Critically analyse the information in different domain and interpret data for developing solutions with valid justifications

Skills

PO4. Exhibit the analytical skills to solve the problems in health sector, IT sector and environmental sector through developing new algorithms and coding using different programming languages

PO5. Acquire ability to comprehend and write effective reports and communicate confidently to share their ideas

PO6. Able to handle societal problems and develop entrepreneurship skills by strategical thinking

Attitude

PO7. Build leadership and teamwork to contribute their expertise to different sectors and extend their support in nation building.

PO8. Ability to adapt according to the technological change and demands of work place through their life-long learning to update their knowledge and developmental skills

PO9. Apply professional ethics and be responsible to pursue the projects related to diverse domains in life science

Program Specific Outcomes (PSOs):

Knowledge:

PSO1. Acquire knowledge and understand the advanced concepts of mathematical science, structural and computational science, biological science and biophysical chemistry of living organisms including their biodiversity.

Skills:

PSO2. Perform protocols as per the laboratory standards in the area related to molecular bioscience, computational biology, high-end programming languages and structural and medicinal chemistry

PSO3. Analyse and interpret the biological data and serve as facilitator to provide bioinformatics solutions using software packages and databases

Attitude:

PSO4. Develop professional skills and acquire ethics fostering for career, research and developmental activities and higher studies in emerging areas of biotechnology and bioinformatics corporate sectors

Programme: M.Sc., BIOINFORMATICS (INTEGRATED) (2023-2024)

Course Structure

Sem.	Part	Course	Course Title	Course Code	Hours / week	Credits	Marks		
							CIA	ESE	Total
I	I	Language I	பொதுத்தமிழ் I	U23TM1L1	6	3	25	75	100
	II	English I	Prose and Short Stories	U23EG1L1	6	3	25	75	100
	III	Core I	Introduction to Computer and Bioinformatics	I23BI101	5	5	25	75	100
		Core Prac. I	Introduction to Computer and Bioinformatics Lab	I23BI1P1	3	3	40	60	100
		Allied I	Cell Biology	I23BI1Y1	3	3	25	75	100
		Allied Prac. I	Cell Biology Lab	I23BIYP1	3	2	40	60	100
	IV	SEC I	Basic Bioinformatics	I23BI1E1	2	2	25	75	100
		FC	Foundation Course for M.Sc., Integrated Bioinformatics	I23BI1N1	2	2	100	--	100
					30	**23**			
II	I	Language II	பொதுத்தமிழ் II	U23TM2L2	6	3	25	75	100
	II	English II	Poetry and Shakespeare	U23EG2L2	6	3	25	75	100
	III	Core II	Computational Biology and Sequence Analysis	I23BI202	5	5	25	75	100
		Core Prac. II	Computational Biology and Sequence Analysis Lab	I23BI2P2	3	3	40	60	100
		Allied II	Biochemistry	I23BI2Y2	3	3	25	75	100
		Allied Prac. II	Biochemistry Lab	I23BIYP2	3	2	40	60	100
	IV	SEC II	Basic Structural Bioinformatics	I23BI2E2	2	2	25	75	100
		SEC III	General Chemistry	I23BI2S3	2	2	25	75	100
					30	**23**			
III	I	Language III	பொதுத்தமிழ் III	U23TM3L3	6	3	25	75	100
	II	English III	One Act Plays and Abridged Novel	U23EG3L3	6	3	25	75	100
	III	Core III	Programming in C and C++	I23BI303	5	5	25	75	100
		Core Prac. III	Programming in C and C++ Lab	I23BI3P3	3	3	40	60	100
		Allied III	Microbiology	I23BI3Y3	3	3	25	75	100
		Allied Prac. III	Microbiology Lab	I23BIYP3	3	2	40	60	100
	IV	SEC IV	Entrepreneurial Opportunities in Life Sciences	I23BI3S4	1	1	100	--	100
		SEC V	Applied Bioinformatics	I23BI3S5	2	2	25	75	100
		EVS	Environmental Studies	U23EST41	1	--	--	--	--
					30	**22**			
IV	I	Language IV	பொதுத்தமிழ் IV	U23TM4L4	6	3	25	75	100
	II	English IV	Language through Literature	U23EG4L4	6	3	25	75	100
	III	Core IV	Vector Algebra and Calculus	I23BI404	5	5	25	75	100
		Core Prac. IV	Octave Programming for Bioinformatics	I23BI4P4	3	3	40	60	100
		Allied IV	Molecular Biology and Genetic Engineering	I23BI4Y4	3	3	25	75	100
		Allied Prac. IV	Molecular Biology and Genetic Engineering Lab	I23BIYP4	2	2	40	60	100
	IV	SEC VI	Life Skills	I23BI4S4	2	2	100	--	100
		SEC VII	In Silico Applications for Crop Development	U23EG4A4	2	2	100	--	100
		EVS	Environmental Studies	U23EST42	1	2	25	75	100
					30	**25**			
V	III	Core V	Structural Bioinformatics and Medicinal Chemistry	I23BI505	5	4	25	75	100
		Core VI	Programming in Perl and Python	I23BI506	5	4	25	75	100
		Core Prac. V	Advanced Bioinformatics Lab - I	I23BI5P5	3	2	40	60	100
		Core Prac. VI	Programming in Perl and PythonLab	I23BI5P6	3	2	40	60	100
		Core Project I	Core Project I with Viva Voce	I23BI5PJ	4	4			
		Elective I	Biophysics	I23BI5:A	4	3	25	75	100
			Database and Tools for Bioinformatics	I23BI5:B					
		Elective II	Biostatistics and Numerical Methods	I23BI5:C	4	3	25	75	100
			Research Methodology	I23BI5:D					
		VLO	Abundant Life	U23VLO51	2	2	100	--	100
			Human Values	U23VLO52					
	IV	Internship	Internship/ Industrial Training Programme	I23BI5I1	--	2	100	--	100
					30	**26**			
VI	III	Core VII	Database Management System and SQL	I23BI607	6	4	25	75	100
		Core VIII	Molecular Modeling and Drug Design	I23BI608	6	4	25	75	100
		Core Prac. VII	Database Management System and SQL Lab	I23BI6P7	3	2	40	60	100
		Core Prac. VIII	Advanced Bioinformatics Lab - II	I23BI6P8	3	2	40	60	100
		Elective III	Biodiversity Informatics	I23BI6:A	5	3	25	75	100
			Immunoinformatics	I23BI6:B					
		Elective IV	Introduction to Internet of things and its applications	I23BI6:C	5	3	25	75	100
			Machine learning in Bioinformatics	I23BI6:D					
		Extension Activity	Extension Activities	I23ETA61	--	1	--	--	--
	V	PCS	Professional Competency to Clear Competitive Examination	I23BI6G1	2	2	25	75	100
					30	**21**			
					Total Credits:	**140**			

PROGRAMME ARTICULATION MATRIX

M.Sc., Bioinformatics (Integrated) Programme(2023–2024 onwards)

Should be marked on H – M - L Scale

S. No	COURSE NAME	CourseCode	P	P	P	P	P	P	P	P	P	PS	PS	PS	PS
1	Introduction to Computerand Bioinformatics	I23BI101	M	-	-	L	-	-	-	M	-	M	-	M	M
2	Introduction to Computerand Bioinformatics Lab	I23BI1P1	M	M	M	M				M	-	M	M	-	M
3	Cell Biology	I23BI1Y1	H	H	L	L	M	L	L	-	-	H	-	L	M
4	Cell Biology Lab	I23BIYP1													
5	Basic Bioinformatics	I23BI1E1	M	M	M	H	-	-	-	-	-	M	M	H	M
6	Foundation Course for M.Sc Integrated Bioinformatics	I23BI1N1													
7	Computational Biology andSequence Analysis	I23BI202	M	M	M	H	-	-	-	-	-	M	M	H	M
8	Computational Biology andSequence Analysis Lab	I23BI2P2	M	M	L	-	-	-	-	-	-	H	H	L	-
9	Biochemistry	I23BI2Y2	H	H	L	L	M	L	L		-	H	M	L	M
10	Biochemistry Lab	I23BIYP2	H	H	L	L	M	L	-	-	-	H	-	L	M
11	Basic Structural Bioinformatics	I23BI2E2													
12	General Chemistry	I23BI2S3	H	H	L	L	M	L	-	-	-	M	-	L	M
13	Programming in C and C++	I23BI303	H	H	L	L	M	-	-	-	-	H	-	L	M
14	Programming in C and C++Lab	I23BI3P3	H	H	L	L	M	-	-	-	-	H	-	L	M
15	Microbiology	I23BI3Y3	H	H	L	L	M	L	-	-	-	H	M	L	M
16	Microbiology Lab	I23BIYP3	H	M	M	L	M	L	-	-	-	M	-	M	L
17	Entrepreneurial Opportunities in Life Sciences	I23BI3S4	M	M	M	H	-	-	-	-	-	M	M	H	M
18	Applied Bioinformatics	I23BI3S5	M	H	L	L	M		L	-	-	H	-	L	L
19	Mathematics- Vector Algebra and Calculus	I23BI404	H	H	L	L	M	L	-	-	-	M	-	L	M
20	Octave Programming forBioinformatics	I23BI4P4	H	M	L	L	L	L	-	-	-	M	-	L	M
21	Molecular Biology andGenetic Engineering	I23BI4Y4	H	H	L	L	M	L	-	-	-	M	-	L	M

S. No	COURSE NAME	CourseCode	P01	P02	P03	P04	P05	P06	P07	P08	P09	PS01	PS02	PS03	PS04
22	Molecular biology and GeneticEngineering Lab	I23BIYP4	H	M	M	L	M	L	-	-	-	M	-	M	L
23	In Silico Applications for Crop Development	U23EG4A4													
24	Structural Bioinformatics and Medicinal Chemistry	I23BI505	M	H	-	L	H	-	-	-	-	H	M	M	H
25	Programming in Perl andPython	I23BI506	H	H	L	L	M	-	-	-	-	H	-	L	M
26	Advanced BioinformaticsLab - I	I23BI5P5	H	H	L	L	M	-	-	-	-	H	-	L	M
27	Programming in Perl andPython Lab	I23BI5P6	M	H	L	L	M	L	M	-	-	M	-	L	M
28	Biophysics	I23BI5:A	M	H	L	L	M	-	M	-	-	M	M	L	M
29	Database and Tools forbioinformatics	I23BI5:B	M	H	L	L	L	-	-	-	-	H	-	L	M
30	Biostatistics and NumericalMethods	I23BI5:C	M	H	L	L	L	-	-	-	-	H	-	L	M
31	Research Methodology	I23BI5:D	M	H	L	L	L	-	L	-	-	H	-	L	L
32	Database ManagementSystem and SQL	I23BI607	H	M	M	L	M	L	-	-	-	M	-	M	L
33	Molecular Modeling andDrug Design	I23BI608	H	M	-	L	L	-	-	-	-	H	L	-	-
34	Database ManagementSystem and SQL Lab	I23BI6P7	H	H	L	L	M	L	-	-	-	M	-	L	M
35	Advanced BioinformaticsLab - II	I23BI6P8	H	H	L	M	M	L	-	-	-	M	-	L	M
36	Biodiversity Informatics	I23BI6:A	H	M	L	L	M	L	-	-	-	M	-	M	L
37	Immunoinformatics	I23BI6:B	H	H	L	M	M	L	-	-	-	M	-	L	M
38	Introduction to Internet of Things and its Applications	I23BI6:C	M	H	L	L	L	-	-	-	-	H	-	L	M
39	Machine Learning in Bioinformatics	I23BI6:D	M	H	L	L	L	-	L	-	-	H	-	L	L
40	Professional Competency to Clear Competitive Examinations	I23BI6G1	H	M	M	L	M	L	-	-	-	M	-	M	L

Structure of the Curriculum for M.Sc Bioinformatics
(2022- 2023)

Parts of the Curriculum		No. of Courses	No. of Hours	Credits	Total Credits
Part – I : Language		4	24	12	12
Part – II : English		4	24	12	12
Part – III Major					
Core (Theory)		8	42	36	60
Core (Practical)		8	24	20	
Core (Project)		1	4	4	
Elective (Theory)		4	18	12	12
Allied Theory	(BT)	4	12	12	12
Allied Practical	(BT)	4	11	8	8
Part – IV					21
SEC		7	13	13	
FC		1	2	2	
VLO		1	2	2	
Env. Studies		1	2	2	
Internship		1	-	2	
Part – V					
Extension		1	-	1	3
PCS		1	2	2	
Total		**44**	**180**	**140**	**140**

Total Courses : 44

Total Credits : 140

Total Hours : 180

Core I : Introduction to Computer and Bioinformatics

Semester: I **Course Code: I23BI101**

Credits : 4 **Hours/ Week: 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Describe the basics of computer	K1	I
CO2	Discuss the components of input, memory and output devices of computers	K2	I
CO3	Demonstrate the mechanism of working of software and hardware	K3	II
CO4	Describe the basics of bioinformatics, scope and its applications	K1	III
CO5	Summarize the details about biological databases	K2	IV
CO6	Classify Secondary Databases	K2	V

2. A. Syllabus

Unit I – Introduction to Computers **12 Hours**

1.1 Understanding the Computer - Introduction -Evolution of Computers-Generations of Computers -Classification of Computers-Computing Concepts - The Computer System - Applications of Computers.

1.2 Computer Organization and Architecture - Central Processing Unit - Internal Communications

1.3 Memory and Storage Systems

1.4 Input Devices

1.5 Output Devices

Unit II – Basics of Networking **12 Hours**

2.1 Computer Software

2.2 Operating Systems

2.3 Microsoft Software

2.4 Data Communications and Networks

2.5 The Internet and World Wide Web

Unit III - Bioinformatics **12 Hours**

3.1. Introduction to Bioinformatics,

3.2 Goals of Bioinformatics

3.3 Scope of Bioinformatics,
3.4 Applications of Bioinformatics
3.5. Limitations
3.6. New themes.
3.7. Bioinformatics web sites

Unit IV - Introduction to Biological Database **12 Hours**

4.1 Introduction to database
4.2 Type of database
4.3 Relational Database
4.4 Object-Oriented Database
4.5 Biological Database-Primary databases-Secondary databases-Specialized Databases-Interconnection between Biological Database
4.6. Pitfalls of Biological Database
4.7. Information Retrieval from Biological Database – Entrez – GenBank- GenBank Sequence Format-Alternative Sequence Formats-Conversion of Sequence Formats

Unit V - Secondary Database **12 Hours**

5.1. Create Secondary database
5.2. Prosite
5.3. Prints
5.4. Blocks
5.5. Profiles
5.6. Pfam
5.7. Identify
5.8. Composite protein pattern databases
5.9. Structure classification databases-SCOP, CATH, PDBsum

B. Topics for Self-Study

S.No.	Topics	Web Links
1	Evolution Of Smart Computers	https://www.youtube.com/watch?v=E0c7M_eEmLE&feature=emb_logo
2	Software and Architecture Types	https://www.youtube.com/watch?v=yMcqE-P7uGA&feature=emb_logo
3	Introduction to Mobile App	https://www.youtube.com/watch?v=m2vLrtxyGuE&feature=emb_logo
4	Database Management System	https://nptel.ac.in/courses/106/105/106105175/
5	Database categories	https://www.youtube.com/watch?v=gh4tJfJCKFo&feature=emb_logo

C. Text Book(s)

1. E Balagurusamy, Fundamentals of computers, Tata McGraw Hill Education Private Limited, New Delhi, 2009.(Unit I - & II)
2. Jin Xiong, Essential Bioinformatics, Cambridge University Press, 2006. (Unit I - II & IV)
3. Attwood T.K and Parry - Smith D.J, Introduction to Bioinformatics, Pearson Education Ltd., New Delhi, 2003. (Unit V) .

D. Reference Book(s)

1. V.Rajaraman, Fundamentals of Computers, PHI Learning Private Limited, 2010.
2. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, NewDelhi, 2003.
3. David W mount, Bioinformatics: Sequence and genome analysis, 2nd edition, CBS publishers, New Delhi, 2004.
4. Manju Bansal, Basic Bioinformatics, Atlantic Publishers & Distributors , 2009.

E. Weblinks

1. https://www.coursera.org/learn/bioinformatics-pku
2. https://onlinecourses.swayam2.ac.in/cec21_bt04/preview
3. https://www.coursera.org/lecture/bioinformatics-pku/overview-of-resources-WlYAG

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Introduction to Computers		
1.1	Understanding the Computer - Introduction - Evolution of Computers-Generations of Computers -Classification of Computers- Computing Concepts- The Computer System- Applications of Computers.	List out the generation of computers	K1
		Identify the principal components of a computer	K1
		Recall the evolution of computer	K1
1.2	Computer Organization and Architecture - Central Processing Unit - Internal Communications	List out the various architecture of computer	K2
1.3	Memory and Storage Systems		
1.4	Input Devices		
1.5	Output Devices		

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2	**Basics of Networking**		
2.1 2.2	Computer Software Operating Systems	Explain the fundamental concepts of computer software	K2
2.3	Microsoft Software	Describe the various components of Microsoft software	K2
2.4 2.5	Data Communications and Networks The Internet and World Wide Web	List the applications of data communication and Internet	K1
3	**Bioinformatics**		
3.1 3.2	Introduction to Bioinformatics, Goals of Bioinformatics	Explain the basics of Bioinformatics	K2
3.3 3.4	Scope of Bioinformatics, Applications of Bioinformatics	Recall the Milestones in Bioinformatics Summarize the various applications in bioinformatics	K1 K2
3.5 3.6 3.7	Limitations New themes. Bioinformatics web sites	List out the useful bioinformatics websites. Identify the innovative ideasin forensic DNA analysis and agricultural biotechnology.	K1 K2
4	**Introduction to Biological Database**		
4.1 4.2 4.3 4.4	Introduction to database Type of database Relational Database Object-Oriented Database	Classify the Databases	K2
4.5	Biological Database -Primary databases -Secondary databases	List out the available Biological Databases	K1
4.6.	-Specialized Databases -Interconnection between Biological Database Pitfalls of Biological Database	Summarize and classify the primary Biological Databases List out the specialized databases	K2 K1
4.7	Information Retrieval from Biological Database -Entrez -GenBank -GenBank Sequence Format -Alternative Sequence Formats -Conversion of Sequence Formats	Retrieve and compare the different sequence formats from biological databases	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5	**Secondary Database**		
5.1 5.2	Create Secondary database Prosite	Summarize and classify the secondary database	K2
5.3 5.4 5.5 5.6 5.7	Prints Blocks Profiles Pfam Identify	Review on secondary databases.	K2
5.8	Composite protein pattern databases	Identify the pattern Databases.	K2
5.9	Structure classification databases-SCOP, CATH, PDBsum	Interpret the structure classification Databases	K2

4. Mapping Scheme

I23BI101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	-	L	M	H	L	L	M	L	M	M	M	M
CO2	L	L	L	L	M	L	-	L	-	-	L	M	-
CO3	-	L	L	H	M	M	L	L	-	L	L	L	L
CO4	-	L	-	L	L	L	-	L	L	L	L	L	L
CO5	L	M	M	L	L	-	-	M	-	H	M	H	M
CO6	H	M	L	M	L	-	-	L	L	H	M	H	M

L: Low M: Medium H: High

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. K. Akila

Core Prac I : Introduction To Computer And Bioinformatics Lab

Semester : I **Course Code : I23BI1P1**

Credits : 2 **Hours/Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Demonstrate the document in proper format, border and word count	K3	1
CO2	Employ worksheet using formulas and functions	K3	2
CO3	Create a power point presentation with animation, audio and video.	K5	3
CO4	Practice the retrieval of Protein and nucleotide sequence using NCBI, EMBL, DDBJ and UniProt	K3	4,5,6
CO5	Differentiate between SCOP and CATH	K4	7
CO6	Analyse the profiles and patterns of the protein sequence	K4	8

2. A. List of Experiments

Ex 1: Fundamentals of Computer Practical

MS-Word

1. To create a Bio-Data
2. To create a document with scientific notation/symbols
3. To create an advertisement
4. To create Table
5. To Draw a Flow Chart

Ex 2: MS-Excel

1. To prepare a Chart / Plot – Line XY, BAR and Pie
2. To create a table of marks of 5 students – Sorting names and marks & using Formula

Ex 3: MS-PowerPoint

1. Prepare a presentation – 10 slides including pictures and tables3:

Software Packages

a. Create a manuscript using MS-word by applying relevant font styles, margins, bullets and tables.

b. Prepare a seasonal greeting to the selected recipients by using mail merge.

c. Prepare a student's fee table for four semesters in a excel sheet. Calculate the consolidated payment using links.

d. Create all types of charts using excel for any clinical data.

Bioinformatics Databases

Ex 4 : Nucleotide Sequence databases: Genbank, EMBL, DDBJ

a. Obtaining a new DNA sequence, from Genbank and test and test for its homologous sequences (sequences which are derived from a common ancestry)

b. From a given a putative coding ORF, search for Homologous proteins (proteins similar in their folding or structure of function).

c. Find similar non-coding DNA stretches in the database : Repeat elements or regulatory sequences for instance.

Ex 5: Protein sequence databases: UniProt

a. Retrieve human insulin sequence

b. How many hits do you find?

c. How many of these hits are from Swiss-Prot?Can you identify the correct hit (which one is actually human insulin and not something else)? If yes, write down its Accession code (found under Entry) and Entry name (also called ID).

d. How many references are there in the insulin entry?

e. Why do you think insulin is such a highly investigated protein? (see other sections of the entry, e.g. Function and Pathol./Biotech, especially the subsections Involvement in disease and Pharmaceutical use)

f. How long is the signal peptide and the propeptide, respectively?

Ex 6: Secondary Structure database: PROSITE, PRINTS, BLOCKS, PROFILES

a. To Submit Insulin Protein Sequence

b. To find Exclude motifs with a high probability of occurrence

c. To find Hits by Profiles

d. To find Hits by Patterns

PFAM

a) To find human insulin sequence

b) To find families, multiple alignments, and annotation

c) To find Domain Organization, Alignment, Trees, Species, Interaction, Structure.

Ex 7: Structure classification databases

a. SCOP

I. To find Human insulin Sequence
II. To find structural Similarity and Common evolutionary origin
III. To find Species, Protein, Family, Superfamily, Fold and Class.

b. CATH

To find human insulin, Summary, Superfamily, Sequence/Structure Diversity

c. PDBsum

To find Human insulin structure

Ex 8: Database formats

Convert Biological File Format to Desired format using ReadSeq

B. Topics for Self-Study

S.No.	Topics	Web Links
1	Introduction to Computers and Office Productivity Software	https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2	Bioinformatics methods-1	https://www.coursera.org/learn/bioinformatics-methods-1

C. Reference Book(s)

1. Baxevanis, A.D. and Francis Ouellellette B.F, Bioinformatics –a Practical Guide to the Analysis of Genes and Proteins , Wiley India Pvt Ltd .2009.
2. V.Rajaraman, Fundamentals of Computers, PHI Learning Private Limited, 2010.

D. Weblinks

1. https://nptel.ac.in/courses/106/106/106106092/
2. http://www.digimat.in/nptel/courses/video/106105034/L01.html
3. http://www.digimat.in/nptel/courses/video/106106093/L01.html

3. Specific Learning Outcomes (SLO)

Ex. No	Course Contents	Learning Outcomes	HBTLT
1	MS-Word To create a Bio-Data	Create Biodata, advertisement, Table and Flowchart	K5
	To create a document with scientific notation/symbols To create an advertisement To create Table To Draw a Flow Chart	Create a manuscript using ms-word by applying relevant font styles, margins, bullets and tables.	K5
	Mail Merge	Prepare a seasonal greeting to the selected recipients by using mail merge.	K5
2	MS Excel To prepare a Chart / Plot – Line XY, BAR and Pie	Design charts using Microsoft office excel sheets.	K5
	To create a table of marks of 5 students – Sorting names and marks & using Formula MS-Excel.	Prepare a student's fee table for four semesters in a excel sheet. Calculate the consolidated payment.	K5
	Create all types of charts using excel for any clinical data.	Design and sort clinical data using excel	K5
3	MS Powerpoint: Prepare a presentation – 10 slides including pictures and tables	Create apowerpoint presentation using images, video clippings, animation and hyperlinks.	K5
4 5 6	Nucleotide Sequence databases NCBI, EMBL, DDBJ Protein sequence databases UniProt Secondary structure database	AnalysetheDNA sequences, Homologous proteins, non-coding DNA stretches from the sequence databases	K4
7 8	Structure classification databases Database formats Database formats	Practice retrieval of structure and its properties from the given Database.	K3

4. Mapping Scheme

I20BI1P1	P01	P02	P03	P04	P05	P06	P07	P08	P09	PS01	PS02	PS03	PS04
CO1	L	L	M	M	L	L	L	L	-	L	L	M	L
CO2	L	L	H	L	M	M	-	M	L	M	L	M	M
CO3	L	-	L	L	M	L	-	M	L	M	L	-	L
CO4	M	M	M	M	L	-	L	L	L	M	L	M	M
CO5	M	M	M	M	L	-	L	L	L	M	L	M	M
CO6	M	M	M	M	L	-	L	L	L	M	L	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. K. Akila

Allied I : Cell Biology

Semester : I **Course Code : I23BI1Y1**

Credits : 4 **Hours/Week : 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Differentiate the organization of prokaryotic and eukaryotic cells	K3	I
CO2	Relate the role of biomolecules in maintaining the plasma membrane stability /function	K2	II
CO3	Analyze and compare the different transport mechanisms available to: transfer the solutes through plasma membrane	K4	III
CO4	Illustrate the structure and organization of various cell organelles	K3	IV
CO5	Describe the various stages of cell cycle and its regulation	K2	V
CO6	Explain the working principle of microscope	K2	I

2. A. Syllabus

Unit I - Ultrastructure and Classification of Cell **12 Hours**

1.1 The cell - Ultrastructure and comparison of microbial, plant and animal cells - Comparison of prokaryotic and eukaryotic cells

1.2 Basis of life-Cells under the microscope-Light microscope

1.3 Electron microscopy-Types-Advanced features and mechanism

Unit II - Structure and Organization of Plasma Membrane and Chromosome **12 Hours**

2.1 Chemical Composition of plasma membrane

2.2 Structure and function of membrane proteins

2.3 Membrane lipid and membrane fluidity

2.4 Dynamic nature of plasma membrane

2.5 Overview of membrane function

2.6 Unit membrane and Fluid mosaic model of membrane

2.7 Chromosome - Chromosome morphology - Chemical components of chromosome

Unit III - Movement of Substance across the Membrane and Cell Signaling 12 Hours

3.1 Active Transport

3.2 Diffusion - Diffusion of water through membrane - Diffusion of ions through membrane -Facilitated diffusion

3.3 Membrane potential and nerve impulse

3.4 Cell signaling through G-protein coupled receptors

3.5 Second messengers

Unit IV - Structure and Organization of Intracellular Organelles 12 Hours

4.1 Structural organization and function - Nucleus, Golgi complex, Endoplasmic reticulum, Vacuoles, Ribosomes and lysosomes, Cytosol - Mitochondria and Chloroplast

4.2 Cytoskeleton

Unit V - Cell Division and Cell Cycle 12 Hours

5.1 Cell Division - Mitosis, meiosis and its regulation

5.2 Steps in cell cycle and control of cell cycle

5.3 Cell death and senescence

B. Topics for Self Study

S.No	Topics	Reference
1	Interaction of cellswith Extracellular Matrix	Gerald, K., Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001
2	Interaction of cells with other cells	Gerald, K., Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001
3	Genetics of Cancer	Gerald, K., Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001
4	Membrane Trafficking	Gerald, K., Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001

C. Text Book(s)

1. Karp, G., Cell and Molecular Biology, Sixth Edition, John Wiley & Sons Publications, 2010.
2. Verma, P.S and Agarwal, V. K., Cell biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand and company, 2005.

D. Reference Book(s)

1. De Robertis E.D.P and De. Robertis E.M.F., Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins Publisher, India, 2005.
2. Cooper G.M and Hausman R.E. The Cell – A molecular Approach, 4th edition, Sinauer Associates Inc. USA, 2007.
3. Lodish H, Berk A, Zipursky S.L, Matsudair P, Baltimore D and Darnell J., Molecular Cell Biology, 4th Edition., W.H Freeman and company, USA, 2000.
4. Verma PS and Agarwal VK, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co, New Delhi, 2005.
5. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian twis, Martin Ratt, Krith Roberts and Peter walter, Essential Cell Biology, Garland Science Publications, Newyork, 2004.

E. Weblinks

1. https://www.coursera.org/lecture/network-biology/introduction-to-cell-biology-r1ahg
2. https://www.youtube.com/watch?v=bvDgAfQlM54
3. https://www.coursera.org/lecture/physiology/about-brlY2

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Ultrastructure and Classification of Cell**		
1.1	The cell Ultrastructure and comparison of microbial, plant and animal cells Comparison of prokaryotic and eukaryotic cells	Distinguish prokaryotic and eukaryotic cells based on their organization	K4
1.2	Basis of life-Cells under the microscope-Light microscope	Explain the components and working of the light microscope	K2
1.3	Electron microscopy-Types-Advanced features and mechanism	Analyze the features and applications of TEM and SEM	K4
2	**Structure and Organization of Plasma Membrane and Chromosome**		
2.1	Chemical Composition of plasma membrane	List out the different types of biomolecules present in plasma membrane	K4
2.2	Structure and function of membrane proteins	Explain the components of peripheral and integral membrane	K2
2.3	Membrane lipid and membrane fluidity	Describe the role of fatty acids in membrane fluidity	K2
2.4	Dynamic nature of plasma membrane	Explain the movement of molecules along the plasma membrane	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2.5	Overview of membrane function	List out the functions of plasma membrane	K2
2.6	Unit membrane and Fluid mosaic model of membrane	Explain the fluid mosaic model of cell membrane	K2
2.7	Chromosome Chromosome morphology Chemical components of chromosome	Discuss the structure of chromosomes	K2
3	**Movement of Substance across The Membrane And Cell Signaling**		
3.1	Active Transport	Explain the mechanism involved in active transport with an example	K2
3.2	Diffusion Diffusion of water through membrane Diffusion of ions through membrane Facilitated diffusion	Analyze the significance of the facilitated diffusion in transport across cell membrane	K2
3.3	Membrane potential and nerve impulse	Relate the role of membrane potential in nerve impulse	K2
3.4	Cell signaling through G-protein coupled receptors	Illustrate the mechanism of cell signaling by G-protein coupled receptors	K2
3.5	Second messengers	List out the second messengers	K4
4	**Structure And Organization Of Intracellular Organelles**		
4.1	Structural organization and function Nucleus, Golgi complex, Endoplasmic reticulum, Vacuoles, Ribosomes and lysosomes, Cytosol Mitochondria and Chloroplast	Describe the structure and function of different cell organelles	K2
4.2	Cytoskeleton	Distinguish microfilaments and microtubules based on its subunits	K4
5	**Cell Division and Cell Cycle**		
5.1	Cell Division Mitosis, meiosis and its regulation	Evaluate the significance of mitosis and meiosis in regulation of cell cycle	K2
5.2	Steps in cell cycle and control of cell cycle	List out the proteins involved in cell cycle	K4
5.3	Cell death and senescence	Describe the process of cell death and senescence	K2

4. Mapping Scheme

I20BI1Y1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	L	-	L	M	L	M	-	M
CO2	L	L	L	L	L	L	-	L	M	L	M	L	M
CO3	L	L	L	L	L	L	-	L	M	L	M	L	M
CO4	L	L	L	L	L	L	-	L	M	L	M	-	M
CO5	L	L	L	L	L	L	-	L	M	L	M	-	M
CO6	L	L	L	L	L	L	L	L	M	L	M	-	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. Melba Priyadharshini

Allied Prac I: Cell Biology Lab

Semester : I **Course Code : I23BIYP1**

Credits : 3 **Hours/Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Identify the mitosis from onion roots	K2	a1
CO2	Interpret the results of barr body staining	K6	a2
CO3	Demonstrate the isolation of DNA from Buccal cells	K3	a3 & a4
CO4	Prepare stock standard and working standard solution	K5	b1, b3, b4
CO5	Perform estimations for protein and glucose	K3	b2,b3, b4
CO6	Analyse the results of basic chromatographic techniques	K4	b5

2. A. List of Experiments

a. Cell Biology

1. Mitosis in onion root tips
2. Barr body staining from buccal epithelial cells
3. Preparation of giant /polytene chromosomes from chironomouslarvae.
4. DNA isolation from Buccal cells

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Cellular organization, Division and Processes	https://nptel.ac.in/courses/102/108/102108086/
2	Biochemical Principles of Energy Metabolism	https://www.coursera.org/learn/energy-metabolism

C. Reference Book(s)

1. Medhi, B., & Prakash, A. (2010). Practical Aspects of Cell Culture. Practical Manual of Experimental and Clinical Pharmacology, 95–95. doi:10.5005/jp/books/11381_6

D. Weblinks

1. https://nptel.ac.in/courses/102/103/102103012/
2. https://nptel.ac.in/courses/102/106/102106025/

3. Specific Learning Outcomes (SLO)

Ex.No	Course Contents	Learning Outcomes	HBTLT
a.1	Mitosis in onion root tips	Define the Different Stages of Cell Division	K1
a.2	Barr body staining from buccal epithelial cells	Explain the reason for the presence of Barr Body in female Epithelial Cells.	K2
a.3	Preparation of giant /polytene chromosomes from chironomous larvae.	Demonstrate the method of staining the Polytene Chromosome.	K3
a.4	DNA isolation from Buccal cells	Practice DNA isolation from Buccal Cells.	K3

4. Mapping Scheme

I20BIYP1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	L	-	L	M	L	L	-	M
CO2	L	L	L	L	L	L	-	L	M	L	L	-	M
CO3	L	L	L	L	L	L	-	L	M	L	L	-	M
CO4	L	L	L	L	L	L	-	L	M	L	L	-	M
CO5	L	L	L	L	L	L	-	L	M	L	L	-	M
CO6	L	L	L	L	L	L	-	L	M	L	L	-	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. S. Sriram

NMEC-I : Basic Bioinformatics

Semester : I **Course Code : I23BI1E1**

Credits : 2 **Hours/Week : 2**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the basics of bioinformatics, scope and its applications	K1	I
CO2	Discuss the important properties of the bioinformatics databases	K2	II
CO3	Summarize the details about nucleotide sequence databases	K2	III
CO4	Explain the steps involved in pairwise and multiple sequence alignment	K2	IV
CO5	Tell the importance ofMetabolic Pathway Databases	K2	IV
CO6	Demonstrate the steps involved in phylogenetic analysis	K3	V

2. A. Syllabus

Unit I - Bioinformatics **6 Hours**

1.1 Introduction to Bioinformatics,
1.2 Milestones in Bioinformatics
1.3 Important Bioinformatics Websites
1.4 Bioinformatics in India
1.5 Dr.Margaret Oakley Dayhoff Pioneer in Bioinformatcs

Unit II- Databases and datamiming **6 Hours**

2.1 Biological Database
  2.1.1 Data and Databases in Computer
  2.1.2 Biological Databases are simple type of Computer Databases
2.2 Structure and Functioning of Biological Databases
2.3 Uses of Maintaining Biological Databases
2.4 Difficulties with Present Day Biological Databases

Unit III - Types of Databases **6 Hours**

3.1 Protein Sequence Database
3.2 Primary Protein Sequence Database

3.3 Secondary Protein Sequence Database
3.4 Structural Protein Database
3.5 Specialized Protein Database

Unit IV - Biological Database **6 Hours**

4.1 Nucleic Acid Database-Types of Nucleic Acid Database-Primary Nucleic Acid Database
4.2 RNA Database
4.3 Specialized Nucleic Acid Databases
4.4 Metabolic Pathway Databases-KEGG as a Model of Metabolic Pathway Database
4.5 Biodiversity Database-Taxonomic vs Observational Biodiversity Database-Major Biodiversity Database
4.6 Bibliographic Databases
    4.6.1 PubMed

Unit V - Sequence Alignment **6 Hours**

5.1 Sequence analysis by Computer Programming-Programming Languages
5.2 Sequence alignment concept-Aligning More than Two sequence
5.3 Methods of Sequence Alignment-Dot Matrix Methods comparision between two sequence
5.4 Multiple Sequence Alignment
5.5 Phylogenetic Analysis

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Complexity of Biological system	https://www.youtube.com/watch?time_continue=1&v=YSh6vm68EoM&feature=emb_logo
2	Database Management System	https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PL3pGy4HtqwD3Ov1J2UBTfsLgxUzUktTAM
3	Bioinformatics: A way to deciphere DNA and cure life's deadliest diseases	https://www.youtube.com/watch?v=_eHz6qzTCfc
4	Computational Problem for Genome Sequencing	https://www.youtube.com/watch?v=eJxP06h-QxE

C. Text Book(s)

Manju Bansal, Basic Bioinformatics, Atlantic Publishers &Distributors , 2009, ISBN 978-81-269-1043-4

D. Reference Book(s)

1. JinXiong, Essential Bioinformatics, Cambridge University Press, 2006, ISBN 978-0-521-70610-0
2. Attwood T.K and Parry - Smith D.J, Introduction to Bioinformatics, Pearson Education Ltd., New Delhi, 2003, ISBN 978-81-7758-641-1
3. Rastogi,S.C. Parag Rastogi, Namita, Bioinformatics Methods andApplications: Genomics Proteomics And Drug Discovery, 3rd Edition, , PHILearning Pvt. Ltd., 2008, ISBN:978-81-203-3595-0.

E. Weblinks

1. https://www.youtube.com/watch?v=zvyv_snBih8
2. https://www.youtube.com/watch?v=RkuvqFfNAis
3. https://www.youtube.com/watch?v=yAjo_x9ylhs

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Bioinformatics**		
1.1 1.2 1.3 1.4 1.5	Introduction to Bioinformatics, Milestones in Bioinformatics Important Bioinformatics Websites Bioinformatics in India Dr.Margaret Oakley Dayhoff Pioneer in Bioinformatcs	Explain the basics of Bioinformatics Recall the Milestones in Bioinformatics	K2 K1
2	**Databases and datamiming**		
2.1 2.1.1 2.1.2 2.2 2.3 2.4	Biological Database Data and Databases in Computer Biological Databases are simple type of Computer Databases Structure and Functioning of Biological Databases uses of Maintaining Biological Databases Difficulties with Present Day Biological Databases	Explain the fundamentals of Biological database List out the available Biological Databases	K2 K1
3	**Types of Databases**		
3.1 3.2 3.3 3.4 3.5	Protein Sequence Database Primary Protein Sequence Database Secondary Protein Sequence Database Structural Protein Database Specialized Protein Database	Summarize and classify the Protein Databases List out the specialized databases	K2 K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4	**Biological Database**		
4.1	Nucleic Acid Database		
4.1.1	Types of Nucleic Acid Database	Retrieve and compare the different sequence formats from biological databases	K2
4.1.2	Primary Nucleic Acid Database		
4.2	RNA Database		
4.3	Specialized Nucleic Acid Databases		
4.4	Metabolic Pathway Databases	Summarize the advantages of Metabolic pathway database	
4.4.1	KEGG as a Model of Metabolic Pathway Database		K2
4.5	Biodiversity Database	Review the information of flora, fauna and microorganisms.	
4.5.1	Taxonomic vs Observational Biodiversity Database		K2
4.5.2	Major Biodiversity Database		
4.6	Bibliographic Databases		
4.6.1	PubMed		
5	**Sequence Alignment**		
5.1	Sequence analysis by Computer Programming	State Sequence Alignment	K1
5.1.1	Programming Languages	Classify Global and Local Alignment Concept	K2
5.2	Sequence alignment concept		
5.2.1	Aligning More than Two sequence		
5.3	Methods of Sequence Alignment		
5.3.1	Dot Matrix Methods comparison between two sequence	Applications of Phylogenetic analysis	K3
5.4	Multiple Sequence Alignment		
5.5	Phylogenetic Analysis		

4. Mapping Scheme

I20BI3E1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	M	L	-	L	L	L	L	M	L	M	L
CO2	L	L	M	L	-	L	L	L	L	M	L	M	L
CO3	L	L	M	L	L	L	L	L	L	M	L	M	L
CO4	L	L	H	M	-	-	-	L	L	M	L	H	L
CO5	L	L	H	M	-	-	-	L	L	M	L	H	L
CO6	L	L	H	M	L	-	-	L	L	M	L	H	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Foundation course for M.Sc Integrated Bioinformatics
(For the candidates admitted from 2023 onwards Under TANSCHE Revised Syllabus)

Semester : I	**Course Code : I23BI1N1**
Credits : 2	**Hours/Week : 3**

UNIT I – Introduction to Computers
Introduction to Computers- Generations of Computers - Classification of Computers - Applications of Computers- Computer Organization and Architecture - Central Processing Unit -Memory and Storage Systems -Input Devices - Output Devices- Application Software Packages- Introduction to Office Packages(Word Processing, Spread Sheet, Presentations).

UNIT II - Introduction to Operating Systems

Introduction to operating Systems - Windows - Comparison of DOS and Windows - Switching between DOS and Windows-Basic DOS commands- File/Directory Manipulations -Copying of files and Disks- Delete/Undelete - UNIX - Basic commands - General purpose, file handling, working with directories - Different File Editors.

UNIT III – Introduction to Programming languages

Introduction to Programming languages-Algorithm, Flowchart, Compiling, Testing and Debugging – Data structures – Array, Stack and Queue-Introduction to Web programming-HTML-Basic Elements, Attributes, Headings ,Paragraphs Styles, Formatting – Images, Tables and Lists

UNIT IV– Introduction to Molecular Biology

Genome – gene / DNA and RNA structure - Watson and Crick model – A, B and Z forms of DNA – RNA secondary structure – DNA-Proteins – Amino acids – Peptide bond - Amino acid properties – Levels of protein structure – Secondary Structure elements –α-helix, β-sheet and β-turns – Types of Proteins – Structural Classification.

UNIT V -Introduction to Bioinformatics

Bioinformatics as an Emerging Discipline- Overview of Available Bioinformatics Resources on the Web-Genome sequencing projects –Biological Sequence versus Structure Deficit–Importance of Bioinformatics - Classification of biological databases, Biological data formats- National Center for Biotechnology Information (NCBI) – Entrez, PubMed– European Molecular Biology network – Applications of Bioinformatics in Various Areas.

TEXT BOOKS

1. E Balagurusamy, Fundamentals of computers, Tata McGraw Hill Education Private Limited, New Delhi, 2009.(UNIT I)
2. Peter Norton, Introduction to Computers, 6th Edition Tata McGraw-Hill Pub. Co.Ltd., New Delhi, 2006. (UNIT I)
3. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill, New Delhi, 2017.(UNIT II)
4. De Robertis E.D.P and De. Robertis E.M.F., Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins Publisher, India, 2005. (UNIT IV)
5. Jin Xiong, Essential Bioinformatics, Cambridge University Press, 2006. (UNIT V)

REFERENCES

1. J. Archer Harris, Schaum's Outline of Operating Systems, McGraw-Hill Education, 2002.
2. Jennifer Robbins, Learning Web Design, 5th Edition, O'Reilly Media, Incorporated, 2018.
3. T.K. Attwood and D J Parry Smith, Introduction to Bioinformatics, Pearson Education, UK, 2007.

Core II : Computational Biology and Sequence Analysis

Semester : II **Course Code : I23BI202**

Credits : 6 **Hours/Week : 6**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the principal of sequence alignment	K2	I
CO2	Analyze the pair wise Sequence alignment methods	K4	II
CO3	Categorize the types of Basic Local Alignment Search Tool	K4	III
CO4	Explain the Motif and Domain Database	K2	IV
CO5	Gene prediction using various probabilistic approaches	K3	V
CO6	Summarize the programmes available for gene finding	K4	V

2. A. Syllabus

Unit I - Sequence alignment **18 Hours**

1.1 Pairwise Sequence alignment
1.2 Evolutionary basis,
1.3 Homology vs similarity
1.4 Similarity vs identity
1.4 Methods in Global and local alignment
1.5 Alignment algorithms- Dot matrix method- Dynamic programming method- Dynamic programming global alignment-GAP, -Dynamic programming Local alignment-SIM,SEARCH, ALIGN
1.6 Introduction to Scoring matrix - Amino Acid Scoring Matrices-PAM Matrices- BLOSUM Matrices-Comparison between PAM and BLOSUM
1.7 Statistical Significance of sequence Alignment

Unit II - Database Similarity Searching **18 Hours**

2.1. Unique requirement of Database Searching
2.2. Heuristic Database Searching
2.3. Basic Local Alignment Search Tool(BLAST)-Variants -Statistical Significance- Low Complexity Region-BLAST output Format
2.4. FAST ALL(FASTA)-Statistical Significance
2.5. Comparison of FASTA and BLAST
2.6. Database Searching with the Smith-Waterman method

Unit III - Multiple sequence alignment **18 Hours**

3.1. Scoring function
3.2. Exhaustive algorithms
3.3. Progressive alignment method-Drawbacks and Solutions
3.4. Iterative alignment-PRRN
3.5. Block-based alignment-Dialign2-Match-Box
3.6. Profile and Hidden Markov models
3.7. Position –Specific Scoring Matrices
3.8. Profiles
3.9. PSI-BLAST
3.10. Markov Model and Hidden Markov Model-Markov Model-Hidden Markov Model
3.11. Phylogenetics Basics-Molecular Evolution and Phylogenetics – Terminology-Gene Phylogeny Vs Species Phylogeny-Forms of Tree Representation

Unit IV - Protein Motif and Domain prediction **18 Hours**

4.1. Identification of Motif and Domains in Multiple Sequence Alignment
4.2. Motif and Domain Database using Regular Expressions – PROSITE-eMotif
4.3. Motif and Domain Database using Statistical Models – PRINTS – BLOCKS – ProDom – Pfam – SMART – InterPro – Reverse-CDART
4.4. Protein family databases –COG-ProtoNet
4.5. Motif Discovery in Unaligned Sequence-Expectation Maximization-Gibbs Motif sampling
4.6. Sequence Logos

Unit V - Gene Prediction **18 Hours**

5.1. Categories of Gene Prediction programs
5.2. Gene Prediction in Prokaryotes-Conventional Determination of Open Reading Frames
5.3. Gene Prediction using Markov Models and Hidden Markov Models
5.4. Performance Evolution
5.5. Gene Prediction in Eukaryotes
5.6. Gene Prediction Programs-Ab Initio Programs-Prediction using Neural Networks-Prediction using Discriminant Analysis-Prediction Using HMM-Homology Based Programs-Consensus Based Programs

B. Topics for Self Study

S.No.	Topics	Web Links
1	Analysis of protein and nucleic acid sequences	https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod6.pdf
2	Bioinformatics Algorithm and Application	nptel/courses/video/102106065/L21.html

S.No.	Topics	Web Links
3	Hidden Markov Model	https://www.youtube.com/watch?v=cjlhpaDXihE
4	Development of algorithms	https://nptel.ac.in/courses/102/106/102106065/
5	Molecular Evolution	https://www.coursera.org/learn/molecular-evolution?specialization=bioinformatics

C. Text Book(s)

1. Jin Xiong, Essential Bioinformatics, Cambridge University Press, 2006 (Unit I – V).

D. Reference Book(s)

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, NewDelhi, 2003.
2. David W mount, Bioinformatics: Sequence and genome analysis, 2nd edition, CBS publishers, New Delhi, 2004.
3. Manju Bansal, Basic Bioinformatics, Atlantic Publishers &Distributors , 2009.
4. Andreas D. Baxevanis , B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, 2005.

E. Weblinks

1. https://www.youtube.com/watch?v=yAjo_x9ylhs
2. https://www.youtube.com/watch?v=0DlPLjHvZaU
3. https://www.coursera.org/lecture/bioinformatics-methods-2/lecture-cbWcT

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Sequence alignment		
1.1	1.1Pairwise Sequence alignment Evolutionary basis, Homology vs similarity similarity vs identity	State Sequence Alignment Define Evolution Relate Homology and Identity	K1
1.2	Methods in Global and local alignment-Alignment algorithms	Classify Global and Local Alignment Concept	K2
	Dot matrix method	Explain Dot Matrix method	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
	Dynamic programming method-Dynamic programming global alignment-GAP, -Dynamic programming Local alignment-SIM,SSEARCH,LALIGN	Tell the Dynamic Programming alignment	K2
1.3	Introduction to Scoring matrix. -Amino Acid Scoring Matrices -PAM Matrices -BLOSUM Matrices -Comparison between PAM and BLOSUM -Statistical Significance of sequence Alignment	Estimate Scoring matrix Compare PAM and BLOSUM matrix	K2
2	**Database Similarity Searching**		
2.1 2.2	Unique requirement of Database Searching - Heuristic Database Searching	List out the requirement for Database Searching	K1
2.3	Basic Local Alignment Search Tool(BLAST) - Variants - Statistical Significance - Low Complexity Region-BLAST output Format	Inspectthesearching toolBlast	K4
2.4 2.5 2.6	FAST ALL(FASTA)-Statistical Significance Comparison of FASTA and BLAST Database Searching with the Smith-Waterman method	Explain the importance of Statistical Significance of FASTA Compare BLAST and FASTA	K2 K2
3	**Multiple sequence alignment**		
3.1	Scoring function	Test Multiple sequence Alignment	K4
3.2	Exhaustive algorithms - Progressive alignment method-Drawbacks and Solutions -Iterative alignment – PRRN - Block-based alignment-Dialign2-Match-Box	Employ Progressive alignment for MSA	K3
3.3	Profile and Hidden Markov models-Position – Specific Scoring Matrices – Profiles-PSI-BLAST - Markov Model and Hidden Markov Model-Markov Model-Hidden Markov Model	Distinguish between Markov Model and Hidden Markov Model	K4
3.4	Phylogenetics Basics-Molecular Evolution and Phylogenetics – Terminology-Gene Phylogeny Vs Species Phylogeny -Forms of Tree Representation	Analyze the significance of Molecular Phylogenetics Construct the phylogenetic tree	K4 K3
4	**Protein Motif and Domain prediction**		
4.1	Identification of Motif and Domains in Multiple Sequence Alignment	Identify the Protein Motif and Domain prediction	K2
4.2	4.2 Motif and Domain Database using Regular Expressions – PROSITE-eMotif	Explain Prosite and eMotif Database	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.3	Motif and Domain Database using Statistical Models – PRINTS – BLOCKS – ProDom – Pfam – SMART – InterPro – Reverse-CDART	Identify the Motif sequence using PRINTS and BLOCKS databases	K2
4.4	Protein family databases – COG – ProtoNet-Motif Discovery in Unaligned Sequence-Expectation Maximization-Gibbs Motif samplingSequence Logos	Discuss Protein family Database Interpret unaligned sequence using Gibbs Motif sampling	K2
5	**Gene Prediction**		
5.1	Gene Prediction Categories of Gene Prediction programs -Gene Prediction in Prokaryotes	Analyze gene prediction in Prokaryotes	K4
5.2	-Conventional Determination of Open Reading Frames	Identify ORF in Prokaryotes	K2
5.3 5.4 5.5 5.6	Gene Prediction using Markov Models and Hidden Markov Models Performance Evolution Gene Prediction in Eukaryotes Gene Prediction Programs	Inspect gene prediction with different models Distinguish between Homology and Consensus based programs	K4 K4

4. Mapping Scheme

I20BI202	P01	P02	P03	P04	P05	P06	P07	P08	P09	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	H	-	-	-	L	-	M	M	H	L
CO2	M	M	M	H	-	-	-	L	-	M	M	H	L
CO3	M	M	M	H	-	-	-	L	-	M	M	H	L
CO4	L	L	M	L	-	-	-	L	-	L	M	M	L
CO5	L	L	M	L	-	-	-	L	-	L	M	M	L
CO6	L	L	M	L	-	-	-	L	-	L	M	M	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Core Prac II : Computational Biology and Sequence Analysis Lab

Semester : II **Course Code : I23BI2P2**

Credits : 2 **Hours/Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Demonstrate pair wise global and local alignment using Dotplot, Emboss Needle and Emboss Water	K3	1, 2
CO2	Analyze Nucleotide and Protein sequence using BLAST and FASTA Programs	K4	2, 3
CO3	Practice the steps used for Multiple Sequence alignment of the given protein and nucleotide sequence using Clustal Omega	K3	4
CO4	Use Expasy for structure analysis through SOPMA	K3	5, 6
CO5	Employ GenMark and GeneScan for gene finding.	K3	7, 8
CO6	Summarize the various literature databases and be aware of the importance of Pubmed and OMIM	K2	9, 10

2. A. List of Experiments

1. Pairwise alignment - Homo sapiens insulin nucleotide and protein sequence
   (i). Global alignment
   (ii). Local alignment
2. Dot matrix method: - Guinea pig's keratin nucleotide and protein sequence
3. Database searching
   (i). BLASTp, BLASTn
   (ii). FASTA
4. Multiple Sequence Alignment & Phylogenetic Analysis - Albumin protein sequence from various organisms - Clustal Omega
5. Protein Structure Alignment – 3DALI
6. Protein sequence analysis : ExPASY
   (i). Aminoacid composition
   (ii). Peptide mass
7. Protein Structure Analysis – ExPASY
   (i). SOPMA
8. Genefinding Method – GenMark/ GeneScan – To predict the coding regions in Homo sapiens sequence.
9. Bioinformatics Literature Search:
   PubMed
10. Bioinformatics Inheritance Search: OMIM

B. Topics for Self Study

S.No.	Topics	Web Links
1	BioInformatics: Algorithms and Applications	https://onlinecourses.nptel.ac.in/noc21_bt06/preview

C. Reference Book(s)

1. Jin Xiong, Essential Bioinformatics, Low Price Edition, Cambridge Press, 2019.
2. Mount D. Bioinformatics : Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York.2004.

D. Weblinks

https://nptel.ac.in/courses/102/106/102106065/
https://onlinecourses.swayam2.ac.in/cec21_bt04/preview

3. Specific Learning Outcomes (SLO)

Ex. No.	Course Contents	Learning Outcomes	HBTLT
1	Pairwise alignment (i). Global alignment (ii) Local alignment	Demonstrate Sequence alignment, Similarity and Identity	K3
2	Dot matrix method		
3	Database searching (i). BLASTp, BLASTn (ii). FASTA	Measure the e-value Relate percent identity and query coverage	K4
4	Multiple Sequence Alignment & Phylogenetic Analysis	Execute the MSA and construct the phylogenetic tree.	K3
5	Protein Structure Alignment – 3DALI	Perform the Structure and sequence analysis	K3
6	Protein sequence analysis : ExPASY (i). Aminoacid composition (ii). Peptide mass		
7	Protein Structure Analysis – ExPASY (i). SOPMA		
8	Genefinding Method – GenMark/ GeneScan	Inspect the Coding regions in DNA sequence	K4
9	Bioinformatics Literature Search :PubMed	Compare the search output of PubMed and OMIM database.	K2
10	Bioinformatics Inheritance Search: OMIM		

4. Mapping Scheme

I20BI2P2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	H	-	-	-	L	-	M	M	H	L
CO2	M	M	M	H	-	-	-	L	-	M	M	H	L
CO3	M	M	M	H	-	-	-	L	-	M	M	H	L
CO4	L	L	M	L	-	-	-	L	-	L	M	M	L
CO5	L	L	M	L	-	-	-	L	-	L	M	M	L
CO6	H	H	M	L	M	L	-	L	L	M	L	L	M

L: Low M: Medium H: High

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Allied II : Biochemistry

Semester : II **Course Code : I23BI2Y2**

Credits : 4 **Hours/Week : 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Recall the basic chemistry of elements & molecules learnt in high school and describe the structure-function aspects of biomolecules	K1	I
CO2	Illustrate the influence of chemical bonding through intra and intermolecular forces in assemblage of higher order structures	K3	II
CO3	Identify the methods of analysis of various biomolecules	K3	III
CO4	Analyze the structure and function of biomolecules and survey their commercial uses.	K4	IV
CO5	Critically appraise theories pertaining to mechanisms of biomolecular action and physiological correlations thereof.	K4	V
CO6	Develop keen understanding to identify, represent and study biological macromolecules and apply knowledge gained in in silico applications	K5	I

2. A. Syllabus

Unit I - Basic Molecules of Life **12 Hours**

1.1. Water –Properties of water;
1.2. pH – Measurement; Determination of pKa-(Henderson Harsel Balch Equation);
1.3. Buffer actions (strong and weak acids) and Biological buffer systems.

Unit II–Carbohydrates **12 Hours**

2.1. Classification of Carbohydrates;
2.2. Monosaccharides- Properties and Classification; Monosaccharides- Glucose and Fructose;
2.3. Oligosaccharides- Classification; Sucrose and Lactose;

2.4. Polysaccharides: Homopolysaccharides – Starch and Glycogen; Heteropolysaccharides – Heparin and Agar-agar;

2.5. Functions of Carbohydrates.

Unit III - Proteins **12 Hours**

3.1. Structure, Classification, Physical and Chemical Properties of Proteins;

3.2. Configuration of Proteins- primary, secondary, tertiary and quaternary structure;

3.3. Biological functions of proteins. Introduction to enzymes, classification, enzyme inhibitors,

Unit IV - Lipids **12 Hours**

4.1. Classification and properties of lipids;

4.2. Simple lipids-Fats and Oils;

4.3. Compound lipids-Phospholipids and Glycolipids;

4.4. Derived lipids- Steroids and Carotenoids;

4.5. Biological importance of lipids.

Unit V - Nucleic Acids and Vitamins **12 Hours**

5.1. Nucleic Acids- Types of DNA and RNA;

5.2. Composition, structure and functions of nucleic acids.

5.3. Vitamins- Deficiencies of Vitamins- Fat soluble-A, D, E & K and Water soluble- B & C.

B. Topics for Self Study

S.No.	Topics	Web Links
1	Redox enzymology: Oxidation and reduction reactions, Nernst equation, measurement of redox potentials	https://ecampusontario.pressbooks.pub/microbio/chapter/energy-matter-and-enzymes/ http://www.chem.ox.ac.uk/vrchemistry/potential/Text/redox1.htm
2	Protein purification methods: role of buffers and detergents	https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-purification-isolation/protein-purification.html
3	Methods for determining biomolecular structure	https://www.photophysics.com/circular-dichroism/biophysical-characterization/
4	Biochemistry of signal transduction	https://www.tocris.com/cell-biology/signal-transduction#:~:text=Signal%20transduction%20(also%20known%20as,initiated%20by%20cell%2Dsurface%20receptors. https://www.sinobiological.com/research/signal-transduction

S.No.	Topics	Web Links
5	Reactive oxygen species in health and disease.	https://www.biotek.com/resources/white-papers/an-introduction-to-reactive-oxygen-species-measurement-of-ros-in-cells/

C. Text Book(s)

1. Arumugam N., Dulsy Fatima, L.M.Narayanan, R.P.Meyyan, K.Nallasingam and S.Prasannakumar. Biochemistry. 5th Edition, Saras Publication, 2014.
2. Jain J.L., Sunjay Jain and Nitin Jain. Fundamentals of Biochemistry, 5th Edition, S. Chand and Company Ltd., New Delhi, 2010.

D. Reference Book(s)

1. Berg J.M., Tymoczko, J.L., Stryer, L. Biochemistry, 7th Edition. W.H.Freeman, USA, 2010.
2. Campbell M.K., Farrell, S.O. Biochemistry, 6th Edition. Brooks Cole Publishing Company, USA, 2007.
3. K. Mathews, (2013) “Biochemistry” 4th Edition, Publisher-Pearson.
4. Voet D., Voet, J.G. and Pratt, C.W. Principles of Biochemistry, 3rd Edition. John Wiley & Sons, USA, 2008.
5. Zubay G.L. Biochemistry, 7th Edition. William C Brown Publishers, NewYork, 1995.
6. Nelson D.L., Cox, M.M. Lehninger Principles of Biochemistry, 5th Edition. W.H Freeman and Company, USA, 2008.

E. Weblinks

1. https://www.youtube.com/watch?v=iuW3nk5EADg
2. https://www.youtube.com/watch?v=ZqoX2W1N6l0
3. https://www.youtube.com/watch?v=DhwAp6yQHQI

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Basic molecules of life**		
1.1	Water –Properties of water	Define the physicochemical properties of water	K1
		Illustrate the various kinds of bonds in water	K2
		Interpret the influence of hydrogen bonding on physicochemical properties	K3
		Discover the role of structural water and influence of water on macromolecular function	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.2	pH – Measurement; Determination of pKa- (Henderson Hassel Balch Equation)	What are acids and bases?	K1
		Explain the concept of pH	K2
		Estimate the concentration of hydrogen ion or hydroxyl ion in solutions	K3
		Measure the pH of a solution using the pH electrode	K4
		Predict the pKa values of compounds using chemoinformatics tools and	K5, K6
		explain the pH-based behaviour of compounds Apply HH equation to find pH	K3
1.3	Buffer actions (strong and weak acids) and Biological buffer systems.	What are acids and bases?	K1
		Identify the roles of acids and bases in biochemical reactions	K2
		Identify the roles of acids and bases in biochemical reactions	K3
		Classify biological buffers based on pH	K2
		Solve biochemical/medical problems related to acid-base imbalance	K5
		Discover the mechanisms of buffering in blood and cells	K4
1.4	Henderson – Hasselbach (HH) equation	Determine the pH of a solution	K3
		Solve for pH using HH equation	K5
		Solve biochemical/medical problems related to acid-base imbalance	K6
2	**Carbohydrates**		
2.1	Classification of carbohydrates	Tell the differences between different kinds of sugars	K1
		Explain the physicochemical properties of carbohydrates Identify sugars based on their chemical properties Classify carbohydrates into different types Estimate the amount of carbohydrates Formulate strategies to research structure-function aspects of carbohydrates	K2 K3 K4 K5 K6
2.2	Monosaccharides- Properties and Classification; Monosaccharides- Glucose and Fructose	Define homoglycans based on their properties	K1
		Classify homoglycans based on chemical composition	K2
		Discover the importance and role of monosaccharides in cell biology and biochemistry	K3
		Develop a deeper understanding of homoglycans	K3
		Contrast homoglycans based on their source and functions	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
		Explain the reaction and chemical properties of homoglycans	K5
		Discuss the structures of homoglycans and their importance in biochemistry	K6
2.3	Oligosaccharides- Classification; Sucrose and Lactose	Tell the differences between various oligosaccharides	K1
		Illustrate the structure-function aspects of salient examples of oligosaccharides	K2
		Identify potential applications of natural carbohydrate oligosaccharides	K3
		Discover methods and strategies to utilize oligosaccharides for human welfare	K4
		Estimate oligosaccharides in samples and discuss their importance in health and human welfare	K5, K6
2.4	Polysaccharides: Homopolysaccharides – Starch and Glycogen;	Define homoglycans based on their properties	K1
		Classify homoglycans based on chemical composition Develop a deeper understanding of homoglycans Contrast homoglycans based on their source and functions Explain the reaction and chemical properties of homoglycans Discuss the structures of homoglycans and their importance in biochemistry	K2 K3 K4 K5 K6
2.5	Heteropolysaccharides – Heparin and Agar-agar; Functions of Carbohydrates	Tell the differences between various heteroglycans Illustrate the structure-function aspects of heteropolysaccharides Identify potential sources for sea weed extraction Discover methods and strategies to utilize heteroglycans for human welfare Estimate heteroglycans and discuss their importance in health and human welfare	K1 K2 K3 K4 K5, K6
3	**Amino acids & Proteins**		
3.1	Structure – Classification, Physical and Chemical Properties of Proteins	Find the importance of protein structure in cellular structure, signalling and the physicochemical properties of proteins Demonstrate clear knowledge of protein classification based on structure-function aspects Develop understanding of methods and assays to estimate proteins based on their physicochemical properties Discuss the specific roles of proteins through use of specific biophysical methods	K1 K2 K3, K5 K6

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3.2	Primary structure, Secondary, tertiary and quaternary structure-	How are proteins able to: maintain their structure? Illustrate various bonds-both covalent and non-covalent in protein structure Develop strategies to study protein structure Discover the mechanisms of protein folding and how enzymes function Examine the contribution of protein side chains and pKa in protein activity	K1 K2 K3 K4
3.3	Biological functions of proteins	Find the important functions of proteins in cells and in physiology Demonstrate clear knowledge of protein classification based on structure-function aspects Develop understanding of methods and assays to estimate proteins based on their physicochemical properties Discuss the specific roles of proteins through use of specific biophysical methods	K1 K2 K3, K5 K6
4	**Lipids and Vitamins**		
4.1	Classification and properties of lipids	Define various types of lipids and outline their biological importance Organize lipids into various classes, subclasses based on their structure Classify lipids based on their reactivity	K1, K2 K3 K2
4.2	Simple lipids – fats and oils Compound lipids-Phospholipids and Glycolipids; Derived lipids-Steroids and Carotenoids	Define fatty acids based on composition, chain length and saturation Classify lipids based on structure, function and their physicochemical aspects Identify the analytical methods for lipid analysis Dissect the biochemical roles of various lipids Determine the concentration of lipids using biochemical and analytical techniques Discuss the role of lipids in health and disease	K1 K2 K3 K4 K5 K6
4.3	Biological importance of lipids	Find the composition and sources of lipids in various cells and tissues Illustrate how lipid structure and composition affects biological functions Discuss how lipids are important in diet, health and disease Perceive and predict physiological ramifications of lipid excess and deficiency	K1 K2 K3 K4 K5, K6

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5		**Nucleic acids & Vitamins**	
5.1	Nucleic Acids- Types of DNA and RNA	Define various types of nitrogenous bases and how they Outline the biological importance of DNA and RNA Organize nucleic acids based on structure and functions Explain how nucleic acids form single, double strand RNA/DNA in various organisms	K1 K2 K3 K5
5.2	Composition, structure and functions of nucleic acids	Define the structure of DNA and RNA based on cell/organism type and chemical composition Classify nucleotides and genetic material based on structure Identify methods used to study nucleic acid structure Dissect the mechanisms of nucleic acid function based on base composition Determine the concentration of nucleic acids using biochemical and analytical techniques Discuss the mechanisms of mutagenesis and how mutations affect structure-function correlations	K1 K2 K3 K4 K5 K6
5.3	Vitamins - Deficiencies of Vitamins- Fat soluble-A, D, E & K and Water soluble- B & C.	Find the composition and sources of vitamins-fat soluble and water soluble Illustrate how vitamin structure influences biological action Discuss how vitamins work as coenzymes or hormones **Assess** the natural sources of vitamins Perceive and predict physiological ramifications of vitamin excess and deficiency	K1 K2 K3 K4 K5, K6

4. Mapping Scheme

I20BI2Y2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book

Open Book Test.

Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).

Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. A. Pricilla

Allied Prac I: Biochemistry Lab

Semester : II | **Course Code : I23BIYP2**

Credits : 3 | **Hours/Week : 3**

3. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Identify the mitosis from onion roots	K2	a1
CO2	Interpret the results of barr body staining	K6	a2
CO3	Demonstrate the isolation of DNA from Buccal cells	K3	a3 & a4
CO4	Prepare stock standard and working standard solution	K5	b1, b3, b4
CO5	Perform estimations for protein and glucose	K3	b2,b3, b4
CO6	Analyse the results of basic chromatographic techniques	K4	b5

4. A. List of Experiments

b. Biochemistry

1. Preparation of solutions
2. Colorimetry – verification of Beer Lambert's law
3. Estimation of glucose by anthrone method
4. Estimation of protein by Bradford method
5. Chromatography – Paper and Thin Layer

E. Topics for Self Study:

S.No.	Topics	Web Links
1	Cellular organization, Division and Processes	https://nptel.ac.in/courses/102/108/102108086/
2	Biochemical Principles of Energy Metabolism	https://www.coursera.org/learn/energy-metabolism

F. Reference Book(s)

1. Medhi, B., & Prakash, A. (2010). Practical Aspects of Cell Culture. Practical Manual of Experimental and Clinical Pharmacology, 95–95. doi:10.5005/jp/books/11381_6

G. Weblinks

1. https://nptel.ac.in/courses/102/103/102103012/
2. https://nptel.ac.in/courses/102/106/102106025/

6. Specific Learning Outcomes (SLO)

Ex.No	Course Contents	Learning Outcomes	HBTLT
Z'b.1	Preparation of solutions	Demonstrate different ways of preparing solutions	K3
b.2	Colorimetry – verification of Beer Lambert's law	Define the concept of Beer – Lambert's Law	K1
b.3	Estimation of glucose by anthrone method	Discuss and interpret the Estimation of Glucose by using Anthrone Method	K2
b.4	Estimation of protein by Bradford method	Discuss and interpret the estimation of Proteins by Bradford Method	K2
b.5	Chromatography – Paper and Thin Layer	Analyse the separated Pigments and Amino Acids by Chromatographic Techniques.	K4

7. Mapping Scheme

I20BIYP1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	L	-	L	M	L	L	-	M
CO2	L	L	L	L	L	L	-	L	M	L	L	-	M
CO3	L	L	L	L	L	L	-	L	M	L	L	-	M
CO4	L	L	L	L	L	L	-	L	M	L	L	-	M
CO5	L	L	L	L	L	L	-	L	M	L	L	-	M
CO6	L	L	L	L	L	L	-	L	M	L	L	-	M

L: Low **M: Medium** **H: High**

8. Course Assessment Methods

Direct

5. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
6. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
7. Pre/Post Test, Viva, Report for each Exercise.
8. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. S. Sriram

SEC II : Basic Structural Bioinformatics

Semester : II **Course Code : I23BI2E2**

Credits : 2 **Hours/Week : 2**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course outcomes	Level	Unit
CO1	Explain the structure of DNA, RNA and proteins	K2	I
CO2	List the biological databases and visualization tools	K1	II
CO3	Describe the steps involved in structure alignment	K2	III
CO4	Categorize the types of protein structure prediction	K4	IV
CO5	Discuss the applications of structural bioinformatics	K2	IV
CO6	Analyse the ADME properties of small molecules	K4	V

2. A. Syllabus

Unit I –Introduction to Bioinformatics **6 Hours**

1.1. Defining bioinformatics & Structural bioinformatics

1.2. Fundamentals of protein structure-fundamentals of DNA & RNA structure

1.3. Organization of structural bioinformatics- Role of structural bioinformatics in Systems biology.

Unit II–Structure database **6 Hours**

2.1. Protein structure Databases- PDB, MMDB,

2.2. Protein structure visualization software- RASMOL - SwissPDBviewer.

Unit III - Structure Alignment **6 Hours**

3.1. Protein structure alignment-Tools used for protein structure alignment-Maxcluster-DaliServer

Unit IV–Structure Prediction **6 Hours**

4.1. Protein 3D Structure Prediction by computation Methods-Homology Modeling – Fold Recognition Methods– ab initio methods

4.2. Structure Validation.

Unit V - Structure based drug design **6 Hours**

5.1. Application of structural Bioinformatics-structure based drug design
5.2. Tools used for structure bases drug design
5.3. ADME properties.

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Defining bioinformatics	https://www.youtube.com/watch?v=2zLn-RngMU4&feature=emb_logo
2	Protein structure visualization	https://www.slideshare.net/vidhyakalaivani29/protein-structure-visualization-toolsrasmol
3	Protein structure alignment	https://www.youtube.com/watch?v=pw-g9WbsdYQ
4	Protein 3D Structure Prediction	https://www.youtube.com/watch?v=x9WAcaQw_Oc
5	Quantitative Struture Activity Relationship(QSAR)	https://www.youtube.com/watch?v=SEXT6Pulxrc

C. Text Book(s)

1. Philip E. Bourne, Helge Weissig, Structural Bioinformatics, John Wiley & Sons, 2003. (Unit-I, Chapter 1,2,3)
2. JinXiong. Essential Bioinformatics. Cambridge University Press 2006(Unit II - P.No.182-186, 187-190, Unit II - I P.No. 190-195, Unit-IV P.No. 214-228)
3. Rastogi,S.C. Parag Rastogi, N. Mendiratta, 4th Edition. 2009 (Unit-V)

D. Reference Book(s)

1. David M, Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory,2004.
2. Branden and J. Tooze, Introduction to Protein Structure, Garland Publishing Inc., New York., 1999.

E. Weblinks

1. https://www.youtube.com/watch?v=zvyv_snBih8
2. https://www.youtube.com/watch?v=vru0-r25Rj4&t=1119s
3. https://www.youtube.com/watch?v=2PBeRbWE79w

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to Bioinformatics**		
1.1 & 1.2	Defining bioinformatics and Structural bioinformatics Fundamentals of protein structure-fundamentals of DNA & RNA structure	Explain the fundamentals of protein, DNA and RNA structure	K2
1.3	Organization of structural bioinformatics- Role of structural bioinformatics in Systems biology.	Discuss the role of structural bioinformatics in systems biology.	K2
2	**Structure database**		
2.1	Protein structure Databases- PDB, MMDB	List the protein structure databases	K1
2.3	Protein structure visualization software- RASMOL – Swiss-PDB viewer.	Name the protein 3D structure visualization tool	K1
3	**Structure Alignment**		
3.1	Protein structure alignment-Tools used for protein structure alignment- Maxcluster-Dali Server	Perform the protein structure alignment	K3
4	**Structure Prediction**		
4.1	Protein 3D Structure Prediction by computation Methods Homology Modeling, Fold Recognition Methods and ab initio methods	Inspect the steps involved in protein 3D structure	K4
4.2	Structure Validation	Interpret the quality of modeled protein structure	K2
5	**Structure based drug design**		
5.1	Application of structural Bioinformatics-structure based drug design	Use bioinformatics for structure based drug designing	K4
5.2	Tools used for structure based drug design	Inspect the new drugs through structure based drug designing	K4
5.3	ADME properties	Calculate the ADME properties of small molecules	K4

4. Mapping Scheme

I20BI4E2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	L	L	M	-	H	M	-	H	H	M	H
CO2	M	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	M	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

SEC –III : General Chemistry

Semester : II **Course Code : I23BI2S3**

Credits : 2 **Hours/Week : 2**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Repeat the basics of atomic and molecular orbital	K1	I
CO2	List the different types of bonded and non-bonded interactions	K1	II
CO3	Describe the principles of bioenergetics	K2	III
CO4	Define the basics of chemical kinetics	K2	IV
CO5	List the forces involved in drug receptor complex	K1	V
CO6	Explain the factors that are affecting the chemical reactions	K2	I

2. A. Syllabus

Unit I - Fundamentals of atomic and molecular orbitals **6 Hours**

1.1. Theory of atomic and molecular orbitals;

1.2. Linear combination of atomic orbitals .Shape of orbitals and hybridization.

1.3. VSEPR Theory- CH_4, NH3, H_2O, PCl_5 and BF_3.

Unit II - Fundamentals of chemical bonding and non-bonding interactions **6 Hours**

2.1. Electrovalent bond, Factors influencing the stability of electrovalent bond.

2.2. Co -valent bond – partial ionic character of co-valent bonds.

2.3. Co-ordination bond, Vander Waals forces.

2.4. Theories of hydrogen bonding and types of hydrogen bonding with examples of RCOOH, ROH, Salicylaldehyde, amides and proteins.

Unit III - Principles of Bioenergitics **6 Hours**

3.1. Free energy, laws of thermodynamics; endergonic and exergonic reactions.

3.2. Role of high energy phosphates in metabolism, metabolic pathways (anabolism,catabolism).

Unit IV - Chemical Kinetics **6 Hours**

4.1. Rate, rate law, order and molecularity of a chemical reaction.

4.2. Rate constant equation for I and II order equation.

4.3. Factors affecting rate of reactions.

Unit V - Receptor Drug Action **6 Hours**

5.1. Forces involved in Drug Receptor Complex:

5.2. Covalent bonds-Electrostatic or ionic interactions-Hydrogen bonds-Charge transfer complexes-Dispersion Forces (Vander waals)

B. Topics for Self Study

S.No	Topics	Weblinks
1	Chemical Bonding	https://www.youtube.com/watch?v=1DWZFkipYtE
2	Chemical Kinetics	https://www.youtube.com/watch?v=T1xbR-MlBvQ
3	Types of Drug Receptors	https://www.youtube.com/watch?v=WORIhbaRABg

C. Text Book(s)

1. ArunBahl and S. Bahl; A text book of Organic chemistry,Chand and company pvt Ltd;2017. (Unit-I)
2. Puri, Sharma, Kalia, Principles of inorganic chemistry, Milestone publisher, India, 2012.(Unit-I,II)
3. Jain J.L.; Sunjay Jain and Nitin Jain, Fundamentals of Bio Chemistry, 6th edition, S. Chand and company pvt Ltd. 2008. (Unit –III)
4. ArunBahl, Bahl.B.S and G.D.Tuli ; Essentials of physical chemistry; S. Chand and company pvt Ltd;2006. (Unit –IV)
5. Ahulwalia.V.K and Madhu Chopra, Medicinal Chemistry, Any Books India, 2008. (Unit-V)

D. Reference Book(s)

1. Bahl.A and Bahl. .S, A text book of organic chemistry, Chand & Company pvt ltd., 2006.
2. Atkins. P, Paula, IX edition, Physical Chemistry, oxford Publications, 2010.
3. Fisher.J, Arnold.J.R.P , Instant notes in chemistry for Biologists,2nd Edition, Taylor & Francis,1999.
4. Mukherji. S.M, Singh. S.P, Reaction Mechanism in Organic Chemistry, Macmillan,1984.

E. Weblinks

1. https://www.coursera.org/lecture/spectroscopy/energy-Level-molecular-orbital-theory-revision-psxkD
2. https://www.coursera.org/lecture/chemistry-1/3-02-types-of-chemical-bonds-0Caf4
3. https://www.coursera.org/lecture/advanced-chemistry/1-01-the-rate-of-chemical-reactions-iBUCv

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course content	Learning Outcomes	HBTLT
1	**Fundamentals of atomic and molecular orbitals**		
1.1	Theory of atomic and molecular orbitals;	Recall the theory of atomic molecular orbitals	K1
1.2	Linear combination of atomic orbitals .Shape of orbitals and hybridization.	List the combination of atomic orbital and the hybridization and shape of orbitals.	K1
1.3	VSEPR Theory- CH_4, NH3, H_2O, PCl_5 and BF_3.	Explain the structure of molecules using VSEPR Theory	K2
2	**Fundamentals of chemical bonding and non-bonding interactions**		
2.1	Electrovalent bond, Factors influencing the stability of electrovalent bond.	Find the types of bonds and their stability.	K1
2.2	Co -valent bond – partial ionic character of co-valent bonds.	Find out the partial ionic character of the compounds.	K1
2.3	Co-ordination bond, Vander Waals forces.	Relate the types of bond and their behavior	K1
2.4	Theories of hydrogen bonding and types of hydrogen bonding with examples of RCOOH, ROH, Salicylaldehyde, amides and proteins.	Find out the type of hydrogen bonds in different types of molecules	K1
3	**Principles of Bioenergitics**		
3.1	Free energy, laws of thermodynamics; endergonic and exergonic reactions.	Compare the laws of thermodynamics in the biological system	K2
3.2	Role of high energy phosphates in metabolism, metabolic pathways (anabolism, catabolism).	Relate the energy in the values in the metabolic pathways	K2
4	**Chemical Kinetics**		
4.1	Rate, rate law, order and molecularity of a chemical reaction.	Summarize the rate and rate law of a chemical reaction	K2

Unit/ Section	Course content	Learning Outcomes	HBTLT
4.2	Rate constant equation for I and II order equation.	Explain the rate equation for the first and second order equation	K2
4.3	Factors affecting rate of reactions.	Interpret the factors affecting the rate of reaction	K2
5	**Receptor Drug Action**		
5.1	Forces involved in Drug Receptor Complex:	Find the factors affecting drug receptor complex	K1
5.2	Covalent bonds-Electrostatic or ionic interactions-Hydrogen bonds-Charge transfer complexes-Dispersion Forces (Vander waals)	Outline the bonding forces involved in the biological system	K2

4. Mapping Scheme

I23BI101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	M	-	H	M	-	H	H	M	H
CO2	L	L	L	L	L	-	L	-	-	H	H	L	-
CO3	L	M	L	L	L	-	-	-	-	M	-	-	M
CO4	L	M	-	-	M	L	-	-	-	H	-	-	M
CO5	M	M	H	L	M	L	-	-	L	M	-	L	L
CO6	L	M	M	M	M	-	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book Open Book Test.
2. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
3. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Elanthamizhan

CORE III : Programming in C and C++

Semester : III **Course Code : I23BI303**

Credits : 6 **Hours/Week : 6**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Practice the basics structure and operations in C and C++ programming languages	K3	I
CO2	Differentiate the various looping and branching techniques in C	K4	II
CO3	Integrate the concepts of user defined datatypes in C	K5	III
CO4	Analyze the advantages of object oriented C++ programming over C	K4	IV
CO5	Assess the input and output operations in C++	K6	IV
CO6	Build the concepts of classes and objects, constructors and inheritance operations in C++	K5	V

2. A. Syllabus

Unit I - Programming in C-Introduction and Basic operations 18 Hours

1.1- Introduction to C- History of C-Importance of C-Basic structure of a C Program-Executing a C Program.

1.2- Character Set-C Tokens-Keywords and identifiers.

1.3- Constants-Integer Constants-Real Constants-String Constants-Backslash Character Constants .

1.4- Variables

1.5- Data types- Integer type, Floating point type, Void and Character types.

1.6- Declaration of variables-Primary type declaration-User defined type declaration.

1.7- Declaration of Storage Class.

1.8- Assigning values to variables, Assignment statement, Defining symbolic constants.

1.9- Operators and expressions, Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise and special, Arithmetic expressions and Precedence of arithmetic operators.

1.10- Data Input and Output operations, Reading a character, Writing a Character, Formatted input and Formatted output.

Unit II - Control structures, Arrays and Functions **18 Hours**

2.1- Decision making and Branching, Decision Making with If statement, Simple IF statement, IF…Else statement, Nesting of IF…Else Statement, The ELSE IF Ladder, switch statements, GOTO Statement.

2.2- Decision making and looping, The WHILE statement, DO statement, FOR Statement.

2.3- Arrays, One dimensional Array, Two dimensional array, Multi-dimensional arrays, Dynamic arrays.

2.4- Character Arrays and strings, Declaring and Initializing String Variables,Readingstrings,Writingstrings,Arithmetic operations on characters,String handling functions.

2.5- Functions Introduction, Need for User-defined functions, Element of User-Definition of functions, Return values and their types, Function Calls, Function declaration, Category of function, Nesting of Functions, Recursion.

Unit III - User defined datatypes and file operations **18 Hours**

3.1- Data Types User defined data types in C. Structures, Declaring structures and Accessing members, Array of structures, Structure within structure. Unions.

3.2- Pointers and File Operations Pointers: Introduction, Accessing the address of the variable, Chain of pointers,pointer expressions, pointers and arrays, pointer and character strings, array of pointers.

3.3- File operations: open, close, reading and writing, Random access files, Command line arguments,Dynamic memory allocation.

Unit IV - Object Oriented Programming with C++ **18 Hours**

4.1- 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 – Introduction to C++, C vs C++.

4.2- Structure of C++ Program, Tokens, expressions, keywords, Identifiers, constants, Operators, Data types , Standard input and output statements , Declaration of variables,Operators in c++.

4.3- C Branching statements ,if and switch statements, looping statements, while,do-while and for statements , goto statement ,sample programs.

Unit V - Classes and Objects,Inheritance **18 Hours**

5.1 Functions in C++,function prototyping, Function & operator overloading, inline functions ,Friend and virtual functions ,Function Overloading.

5.2 Classes and Objects, Creating a class, Defining member functions, Creating objects, Accessing class members, Arrays within a class, Arrays of objects,Friendfunction,Local classes.

5.3 Constructor,Different forms of Constructor, Destructor,Copy constructor.

5.4 Inheritance ,Single, Multiple and Multi level inheritance

B. Topics for Self Study

S.No	Topics	Web Links
1.	Data structures and algorithms in C and C++	https://www.programiz.com/dsa
2.	Computational thinking for problem solving	https://www.coursera.org/learn/computational-thinking-problem-solving
3.	Bio C++	https://bmcbioinformatics.biomedcentral.com/articles/10.1186/1471-2105-7-188

C. Text Book(s)

1. E. Balagurusamy (2018), "Programming in ANSI C ", Tata McGrawHill Education, Seventh Edition.
2. Balagurusamy, E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt Ltd, 5th Edition, 2011

D. Reference Book(s)

1. Byron S. Gottfried, Schaum's outline of Theory and Problems of Programming with C,TataMcGraw,Hill,New Delhi,1991.
2. BrainW.Kernighan and Dennis. M.Ritche, The C Programming Language, Second Edition, Printice, Hall of India, 1988.
3. Parthasarathy S, Essentials Of Computer Programming in C for Life Science,AneBooks,NEW DELHI,2008.
4. BjarneStroustrup," The C++ Programming Language", Third Edition, Imprint of Addison Wesley Longman, Inc., 2003.

E. Weblinks

1. https://www.coursera.org/specializations/c-programming
2. https://www.mooc-list.com/course/sc-competitive-programming-coursera
3. https://onlinecourses.nptel.ac.in/noc21_cs02/preview

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Programming in C-Introduction and Basic operations		
1.1	Introduction to C- History of C-Importance of C-Basic structure of a C Program-Executing a C Program.	State the importance of C programming Describe the basic structure and execution of C program	K1 K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.2	Character Set-C Tokens-Keywords and identifiers.	Name the Character Set,Tokens, Keywords and identifiers.	K1
1.3 &1.4	Constants-Integer Constants-Real Constants-String Constants-Backslash Character Constants.Variables	Illustrate the concepts of variables and constants	K2
1.5	Data types- Integer type, Floating point type, Void and Character types.	Classify the various datatypes in C	K2
1.6 & 1.7	Declaration of variables-Primary type declaration-User defined type declaration Storage Classes	Tell the declaration of variables and storage classes	K2
1.8	Assigning values to variables, Assignment statement, Defining symbolic constants.	Explain how to assign variables	K2
1.9	Operators and expressions, Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise and special, Arithmetic expressions and Precedence of arithmetic operators.	Construct operators and Expressions in C	K3
1.10	Data Input and Output operations, Reading a character, Writing a Character, Formatted input and Formatted output.	Use data input and output operations in C	K3
2	**Control structures, Arrays and Functions**		
2.1	Decision making and Branching, Decision Making with If statement, Simple IF statement, IF…Else statement, Nesting of IF…Else Statement, The ELSE IF Ladder, switch statements, GOTO Statement.	Construct various decision making and branching statements	K3
2.2	Decision making and looping, The WHILE statement, DO statement, FOR Statement.	Demonstrate the various decision making and looping statements	K3
2.3	Arrays, One dimensional Array, Two dimensional array, Multi-dimensional arrays, Dynamic arrays.	Classify the types of arrays in C programming	K2
2.4	Character Arrays and strings, Declaring and Initializing String Variables, Reading strings, Writing strings, Arithmetic operations on characters, String handling functions.	Apply various concepts of arrays and string handling functions in C programming	K3
2.5	Functions Introduction, Need for User-defined functions, Element of User-Definition of functions, Return values and their types, Function Calls, Function declaration, Category of function, Nestingof Functions, Recursion.	Plan the working of function operations and categorize it	K5

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3	**User defined datatypes and file operations**		
3.1	Data Types User defined data types in C. Structures, Declaring structures and Accessing members, Array of structures, Structure within structure. Unions.	Apply the concept of user defined datatypes in C programming	K3
3.2	Pointers and File Operations Pointers: Introduction, Accessing the address of the variable, Chain of pointers,pointer expressions, pointers and arrays, pointer and character strings, array of pointers.	Develop a C program on their own by using pointers	K5
3.3	File operations: open, close, reading and writing, Random access files, Command line arguments,Dynamic memory allocation.	Test the programming codes by using file operations	K4
4	**Object Oriented Programming with C++**		
4.1	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 – Introduction to C++, C vs C++.	Recall the concept of Programming in C Relate C programming with C++ programming	K1 K4
4.2	Structure of C++ Program, Tokens, expressions, keywords, Identifiers, constants, Operators, Data types , Standard input and output statements , Declaration of variables,Operators in c++.	Illustrate the basic structure of a C++ program and its standard input and output statements with operators	K2
4.3	C Branching statements ,if and switch statements, looping statements, while,do-while and for statements , goto statement ,sample programs.	Construct decision making and branching statements in C++ program	K3
5	**Classes and Objects, Inheritance**		
5.1	Functions in C++,function prototyping, Function & operator overloading, inline functions ,Friend and virtual functions ,Function Overloading.	Apply the basic concepts of Object Oriented programming in C++	K3
5.2	Classes and Objects, Creating a class, Defining member functions, Creating objects, Accessing class members, Arrays within a class, Arrays of objects,Friendfunction,Local classes.	Create classes and objects by accessing its members,array of objects and friend functions	K5
5.3	Constructor,Different forms of Constructor, Destructor,Copy constructor.	Build the concepts of Classes and Objects using constructor and destructor	K5

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5.4	Inheritance ,Single, Multiple and Multi level inheritance	Integrate the mechanism of deriving new class from existing class with the help of code reusability by using Inheritance in C++	K5

4. Mapping Scheme

I23BI303	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M	H	-	L	L	L	M	H	H	H	H
CO2	L	M	M	H	-	L	L	L	M	H	H	H	H
CO3	L	M	M	H	-	L	L	L	M	H	H	H	H
CO4	L	M	M	H	L	L	L	L	M	H	H	H	H
CO5	L	M	M	H	-	L	L	L	M	H	H	H	H
CO6	L	M	M	H	-	L	L	L	M	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. Sherlin Rosita

CORE PRAC : III. Programming in C and C++ LAB

Semester : III **Course Code :I23BI3P3**

Credits : 2 **Hours / Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	State the basics of programming	K1	1,2,4
CO2	Discuss the need for programming in Biology	K2	3,5
CO3	Apply programming concepts to analyze molecular sequences	K3	6,7,9
CO4	Relate object oriented programming with Bioinformatics and its role in handling complex data	K4	8,11,12,17
CO5	Develop efficient skills in file managing operations	K5	7,10,13,16
CO6	Create various operations on classes and objects in C++	K5	14,15

2. A. List of Experiments

1. Write C programs for the following

a. Compute the area and the circumference of the circle
b. Compute the volume of a cylinder and cone
c. Find the pH of a solution given the concentration of H+ (or) OH- ions
d. Convert the given Fahrenheit value to centigrade scale (or vice versa)
e. Compute the relative centrifugal force using r_max (in cm) and rpm value
f. Compute the rpm value using r_max (in cm) and RCF value
g. Find the molecular weight of a DNA with n base pairs in length

2. Compute the following using Decision making and Branching statements

a. Find the biggest of three given numbers using if-else statement
b. Compute all possible roots of quadratic equation using if-else statement

3. Compute the nature of the solution based on the pH value using switch case statement.

4. Compute the following using Looping statements

a. Find the sum of n natural numbers

b. Find sum of odd numbers and even numbers

c. Find the factorial of a given integer number

5. Compute the following using Control structures

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

b. Determine the percentage of a,t,g,c in the given sequence

6. Compute the following using the concept of Array

a. Calculating the reverse complement of the given sequence 21

b. Searching for MOTIF in the given sequence

c. Swap two numbers using pointers

7. Compute the following using file operations

a. Convert the DNA sequence into RNA sequence using text file

b. Read the text from a file and convert the text into upper case letters and print the result.

8. Write C++ programs for the following

a. Calculate Body Mass Index (BMI) value.

b. Calculate pH of the solution using H+ ion.

c. Calculate Average Molecular Weight of DNA.

d. Check the Palindrome of a given sequence.

9. Compute multiplication & Division of two numbers using inline functions.

10. Compute Simple Interest using Default Arguments.

11. Write a C++ program with the following specifications :

Define a class to represent a gene sequence data and include the following members:

Data members: Name of the gene gene id, length, a,t,g,c content

Member functions: To read data for a gene, To compute a,t,g,ccontent,To display all the details of a gene and test the program by reading n gene sequences data

12. Compute Volume of Cube, Cylinder & Rectangular Box using function overloading.

13. Find the sum of two complex numbers using overloaded constructors for data input and operator overloading.
14. Compute area and perimeter of a rectangle using multiple inheritance.
15. Compute the Mean Value using friend function.
16. Create a student database using the concepts of Classes & Objects.

B. Topics for Self Study

S. No	Topics	Web Links
1.	C for Everyone: Programming Fundamentals	https://www.coursera.org/learn/c-for-everyone
2.	Advanced C programming : Pointers	https://www.udemy.com/course/advanced-c-programming-pointers/

C. Reference Book(s)

1. Parthasarathy S, Essentials Of Computer Programming in C for Life Science,AneBooks,NEW DELHI,2008.

D. Weblinks

1. http://www.digimat.in/nptel/courses/video/106105151/L01.html
2. http://www.digimat.in/nptel/courses/video/106105166/L01.html

3. Specific Learning Outcomes (SLO)

Ex. No	Course Contents	Learning Outcomes	HBTLT
1.	Write simple C programs for the following	Perform basic programming in C with the help of main function	K3
2.	Compute the following using Decision making and Branching statements	Build a program to find the biggest of three numbers and quadratic equation using Decision making and Branching statements	K5
3.	Compute the nature of the solution based on the pH value using switch case statement.	Analyze the pH value of the solution using switch control structure	K4
4.	Compute the following using Looping statements	Construct a program to find the sum of n natural numbers, sum of odd and even numbers using looping control structures	K3
5.	Compute the following using Control structures	Calculate the molecular weight of the DNA and find its nucleotide percentage using control structures	K4

Ex. No	Course Contents	Learning Outcomes	HBTLT
6.	Compute the following using the concept of Array	Calculate the reverse complement in the given sequence using array. Test the motif in the given sequence with the help of array. Use array of pointers to swap two numbers.	K4 K4 K3
7.	Compute the following using file operations	Develop a program using the concept of file operations to convert the biological sequences	K5
8.	Write C++ programs for the following	Perform a basic C++ program to calculate BMI,pH of a solution,molecular weight of a DNA	K3
9.	Compute multiplication & Division of two numbers using inline functions.	Apply the concept of inline functions to compute multiplication & Division of two numbers	K3
10.	Compute Simple Interest using Default Arguments.	Calculate Simple Interest using Default Arguments.	K4
11.	C++ program to define a class to represent a gene sequence data	Design a C++ program to read the gene sequence	K5
12.	Compute Volume of Cube, Cylinder & Rectangular Box using function overloading.	Calculate theVolume of Cube, Cylinder & Rectangular Box using function overloading.	K4
13.	Find the sum of two complex numbers using overloaded constructors for data input and operator overloading.	Create a Program to find the sum of two complex numbers using overloaded constructors for data input and operator overloading.	K5
14.	Compute area and perimeter of a rectangle using multiple inheritance.	Apply the concept of multiple inheritance to compute area and perimeter of a rectangle	K3
15.	Compute the Mean Value using friend function.	Measurethe Mean Value using friend function.	K4
16.	Create a student database using the concepts of Classes & Objects.	Design a C++ program to Create a student database using the concepts of Classes & Objects.	K5

4. Mapping Scheme

I23BI3P3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	L	M	L	L	M	M	L	H	H	M	M
CO2	M	H	L	M	L	L	M	M	L	H	H	M	M
CO3	M	H	L	M	L	L	M	M	L	H	H	M	M
CO4	M	M	-	-	-	-	-	L	M	M	-	-	M
CO5	H	M	H	L	M	-	-	-	L	M	-	L	L
CO6	H	M	M	M	M	L	M	M	-	M	L	L	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Shelin Rosita

Allied III : Microbiology

Semester : III | **Course Code : I23BI3Y3**

Credits : 3 | **Hours / Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the history, classification and scope of microbiology	K1	I
CO2	List out the types of culture media and factors affecting the growth of microbes	K1	II
CO3	Discuss the methods used for controlling the growth of microorganisms	K2	III
CO4	Inspect the applications of microbes in day today life	K4	IV
CO 5	Use microorganisms to produce useful products	K4	IV
CO 6	Explain the types of microbial diseases	K2	V

2. A. Syllabus

Unit I - Introduction to microbiology **12 Hours**

1.1. Scope & History of microbiology-contributions by Louis Pasteur and Robert Koch,

1.2. Microbial Classification -kingdom concept-3 Kingdom, 5 Kingdom, Characteristic features of Bacteria, Fungi, Virus.

Unit II - Growth & Culture of Bacteria **12 Hours**

2.1. Culture media- Types-Liquid and solid.

2.2. Bacterial growth curve,Determination of growth & factors affecting growth.

2.3. Methods of preservation.

Unit III - Control of microorganisms **12 Hours**

3.1. Control of organisms by physical agents-heat, low temperature, radiation, filtration;

3.2. Chemical agents-alcohols, halogens, aldehydes;

3.3. Antibiotics-mode of action of Penicillin, Streptomycin and Tetracycline.

Unit IV - Agricultural and Industrial applications **12 Hours**

4.1. Bio pesticides-advantages and mode of action - Bacillus thuringiensis, Biodegradation.

4.2. Microbial production of Alcohol-Ethanol, antibiotic-Penicillin, Vitamins-Vitamin B.

Unit V - Microbial Diseases **12 Hours**

5.1. Water borne (cholera), food borne (typhoid), air borne (pneumonia).

5.2. Fungal- Dermatitis, Viral disease- HIV, Flu Virus H1N1, Dengue, Zika Virus.

B. Topics for Self Study

S.No	Topics	Web links
1.	Microbes as Probiotics	https://www.health.harvard.edu/staying-healthy/the-benefits-of-probiotics
2.	Phytoremediation	https://www.nature.com/scitable/knowledge/library/phytoremediation-17359669/
3.	Biodetoriation	https://www.slideshare.net/SureshKumarPandian/biodeterioration
4.	Bioleaching	https://www.azomining.com/Article.aspx?ArticleID=1095

C. Text Book(s)

1. Rajan.S, Essential of Microbiology, Anjana Book house publishers, First edition, 2015. (Unit-I & II)
2. Maheshwari, D.K, Dubey, R.C. A Textbook Of Microbiology by S.Chand& Company Ltd - New Delhi, 2013.(Unit II - I)
3. Arora, D.R. Textbook of Microbiology, CBS, 5th Edition ,2016 (Unit-IV)
4. JayaramPaniker, C.K, Jaypee Brothers Medical Publishers Private Limited; 7 edition, 2013.(Unit-V)

D. Reference Book(s)

1. Prescott, Harley and Klein's Microbiology 8th edition (Willey, Sherwood, Woolverton), 2002.

E. Weblinks

1. https://nptel.ac.in/courses/102/103/102103015/
2. https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
3. https://dth.ac.in/medical/course.php

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to microbiology**		
1.1	Scope & History of microbiology	Summarize the contributions of various scientists to microbiology	K2
1.2	Characterization, classification – Bacteria- 3 Kingdom, 5 Kingdom concepts, Fungi, Virus	Classify microorganism based on their characteristics.	K2
2	**Microorganisms, Cultivation and maintenance**		
2.1	Culture media, Types of Culture media, cultivation, preservation of culture	State the different types of culture media.	K1
2.2	Growth, growth curve. Measurements of growth & factors affecting growth.	Discuss the growth curve of bacteria and the factors affecting the growth of bacteria	K2
3	**Control of microorganisms**		
3.1	Control of organisms by physical agents, chemical agents	Describe the physical and chemical agents use to control the growth of microorganisms	K2
3.2	Chemotherapeutic agents (Penicillin,Streptomycin,Tetracyclin)	Illustrate the mode of action of the antibiotics on pathogens	K2
4	**Environmental & Industrial uses**		
4.1	Extremophiles, thermophiles & methanogens	Analyze the mechanism involved in degrading the pollutants and xenobiotics by genetically modified microbes	K4
4.2	Alcohol production & penicillin production by bacteria & Yeast.	Production of commercially important microbial metabolites in bioreactors using microbes.	K3
4.3	Enzyme extraction and purification	Discuss the steps involved in extraction and purification of enzymes	K2
5	**Microbial Diseases**		
5.1	Water borne (cholera), food borne (typhoid), air borne (pneumonia).	Describe the various microbial diseases mentioning the symptoms, pathogenesis and treatment.	K2
5.2	Fungal- Dermatitis, Viral disease- HIV, Flu Virus H1N1, Dengu, Zika Virus.	Differentiate between fungal, viral and protozoan diseases.	K4

4. Mapping Scheme

I20BI3Y3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	-	L	-	L	L	L	L	L	-	-	L
CO2	-	-	-	L	-	L	-	-	L	L	L	-	L
CO3	-	-	-	L	-	L	-	-	L	L	L	-	L
CO4	-	-	-	L	-	L	-	-	L	L	L	-	L
CO5	L	L	L	M	-	L	L	L	M	L	L	L	M
CO6	L	L	-	M	L	L	L	L	M	L	L	-	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. N. Sharly Elgal

Allied Prac II : Microbiology Lab

Semester : III **Course Code : I23BIYP3**

Credits : 3 **Hours / Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO	Course Outcomes	Level	Experiment
CO1	Identify the microbes under the microscope	K2	a1
CO2	Differentiate gram positive bacteria from gram negative bacteria	K4	a2
CO3	Categorize microbes using plating techniques	K4	a3
CO4	Analyze the isolated DNA from buccal and bacterial cell	K3	b1&b2
CO5	Demonstrate agarose gel electrophoresis	K3	b3
CO6	Illustrate the mechanism of Restriction digestion of DNA and southern blot hybridization	K2	b4&b5

2. A. List of Experiments

a. Microbiology

1. Simple staining
2. Gram staining
3. Pure culture techniques-streak, spread and pour plate

B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Media Preparation	https://bio.libretexts.org/Learning_Objects/Laboratory_Experiments/Microbiology_Labs/Microbiology_Labs_I/01%3A_Media_Preparation
2.	Antimicrobials	https://bio.libretexts.org/Learning_Objects/Laboratory_Experiments/Microbiology_Labs/Microbiology_Labs_I/10%3A_Antimicrobial_Chemicals
3.	PCR	https://learn.genetics.utah.edu/content/labs/pcr/

C. Reference Book(s)

1. Sambrook, J and Green, M. R., Molecular Cloning: A Laboratory Manual, 2012, Fourth Edition, Cold Spring Harbor Laboratory Press.

D. Web links

1. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf 2. https://nptel.ac.in/courses/102/104/102104052/

3. Specific Learning Outcomes (SLO)

Exercises	Course Contents	Learning Outcomes	HBTLT
1	Simple staining	Analyze the size, shape and arrangement of a specimen	K4
2	Gram staining	Distinguish between gram positive and gram negative bacteria	K4
3	Pure culture techniques, streak, spread and pour plate	Design a protocol to isolate the bacteria using plating techniques	K5

4. Mapping Scheme

I20BIYP2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M	L	M	L	L	-	L	L	-	L
CO2	L	L	L	M	L	M	L	L	-	L	L	-	L
CO3	L	L	L	M	L	M	L	L	L	L	L	-	L
CO4	L	L	L	M	L	M	L	L	L	L	L	-	L
CO5	L	L	L	M	L	M	L	L	-	L	L	-	L
CO6	L	L	L	M	L	M	L	L	L	L	L	-	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M.Gananraj

ENTREPRENEURIAL OPPORTUNITIES IN LIFE SCIENCES

Semester : III		**Course Code : I23BI3S4**
Credits :		**Total Hours :**

COURSE OUTCOMES

After completion of this course, the students will be able to

S.No	Course Outcomes	Blooms Taxonomic levels of Transaction	Units Covered
CO1	Describe the basics of entrepreneurship	K1	I
CO2	Discuss the financial management for enterprise	K2	II
CO3	Theorize the various operations involved in venture creation	K4	III
CO4	Catalogue the schemes promoted through knowledge centres and various agencies	K4	III
CO5	Discuss the scope for entrepreneurship in biosciences	K2	IV
CO6	Summarize the role of branding and marketing in entrepreneurship	K2	V

UNIT I: Basics of Bioentrepreneurship

Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations – Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India)

UNIT II: Concepts and Functions of Entrepreneurship

Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. Market Conditions, Identifying the need of the customers

UNIT III: Introduction to MSME

Medium & Small Scale Industry Definition, characteristics, need and rationale, objectives, scope and advantages of small scale industries. Biopharma industries, pharmaceutical formulation, Genome Sequence Analysis, NGS based companies, Biocoding industries, Ancillary and tiny industries

UNIT IV: Marketing and Human Resource Development - I

Marketing and Human Resource Development Assessment of market demand for potential product(s) of interest, Market conditions, segments, prediction of market changes, identifying needs of customers including gaps in the market.

UNIT V: Marketing and Human Resource Development - II

Branding issues, developing distribution channels – franchising policies, promotion, advertising, branding and market linkages. Marketing of agro products. Recruitment and selection process, leadership skills, managerial skills, organization structure, training, team building and teamwork.

TEXT BOOKS:

1.“Principles of Management”, PC Tripati, PN Reddy,–Tata Mc Graw Hill.

2. “Dynamics of Entrepreneurial Development & Management” Vasant Desai Himalaya Publishing House.

3. “Entrepreneurship Development – Small Business Enterprises” Poornima M, Charanthmath Pearson Education – 2005.

4. “Entrepreneurship and Business of Biotechnology”, S. N. Jogdand, Himalaya Publishing Home, 2007.

5. “Entrepreneurship and small Business Management”, C. B. Gupta and S. S. Khanka, 1996.

6. “Pharmaceutical Formulation: The Science and Technology of Dosage Forms”, Geoffrey D. Tovey, 2018.

REFERENCE BOOKS:

1. “Management Fundamentals ”, Robert Lusier – Concepts, Application, Skill Development” Thomson .

2. “Entrepreneurship Development” S S Khanka , S Chand & Co .

3. “Management”, Stephon, Robbins, Pearson Education , 17th Edition (2003).

SEC V : Applied Bioinformatics

Semester : III **Course Code : I23BI3S5**

Credits : 2 **Hours/Week : 2**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Explain the Microarray, Functional Genomics and Computational Tools useful for Bioinformatics Research	K2	I
CO2	Use the In silico prediction of SSR and SNP. Chromosomes and nuclear DNA amount to deduce Evolutionary Relationship of the species.	K3	II
CO3	Identify the Molecular Evolution and Phylogenetic analysis and plant DNA Barcoding	K2	III
CO4	Apply Quantum Mechanical Methods to accurate in silico Drug designing	K3	IV
CO5	Analyse the Computational Toxicology	K4	IV
CO6	Discuss the Computational statistics and computational Biology in Bioinformatics	K2	V

2. A. Syllabus

Unit I –Microarray and its Applications **6 Hours**

1.1 Introduction to Microarray
1.2 Application of Microarray
1.3 Data analysis
1.4 Functional Genomics
1.5 Software Tools and Resources for Bioinformatics Research
1.6 Database, Web Resources and Computational Tools useful for Bioinformatics Research

Unit II – Introduction to Proteomics **6 Hours**

2.1 Bioinformatics Studies in Plants
2.2 Computational Biology and Bioinformatics Driven Research in Catfish
2.3 Recent Trends in Fish Genomics
2.4 Advances in proteomics, Principles, Methods and Bioinformatics
2.5 Expressed Sequence Tags

2.6 Insilico prediction of SSR and SNP

2.7 Chromosomes and nuclear DNA amount to deduce Evolutionary Relationship of the species.

Unit III–Sequence Analysis through Phylogeny 6 Hours

3.1 Molecular Evolution and Phylogenetic analysis

3.2 Computational Phylogenicity of Biological pathway

3.3 Plant DNA Barcoding

3.4 Phylogenetic analysis of Microbes using Bioinformatics Tools

3.5 Construction of Phylogenetic Tree

3.6 Barriers of gene flow and crossability of species in relation to Phylogenic position

Unit IV–Applications of Applied Bioinformatics 6 Hours

4.1 High Throughput Biomedical Instrumentations and use in Medical Bioinformatics

4.2 Genome and personalized Medicine

4.3 Computational Toxicology

4.5 Quantum Mechanical Methods applied to accurate in silico Drug designing

4.6 Active Site Prediction

4.7 Bioinformatics approach in phytoremediation

Unit V –Advanced Applications of Applied Bioinformatics 6 Hours

5.1 Application of Computational statistics and computational Biology in Bioinformatics

5.2 Advances statistical Methods in Bioinformatics

5.3 Statistical Tools in Agricultural Bioinformatics

5.4 Theory of probability and its application in Bioinformatics

5.5 Data mining and Pattern analysis of molecular data

5.6 Data Mining and Text Mining in Bioinformatics

5.7 Current Socio-economic and Environment issues of genetically modified crops

5.8 Ethics and issues of biotechnologically and Genetically modified Crops.

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Microarray	https://www.youtube.com/watch?v=88rzbpclscM&feature=emb_logo
2	Computational Biology and Bioinformatics	https://www.youtube.com/watch?v=rgkku70rZGM
3	DNA Barcoding	https://www.youtube.com/watch?v=wKt0sAV51Xs

S.No.	Topics	Web Links
4	Computational Toxicology Models	https://www.youtube.com/watch?v=H0XrYk-aECo
5	Computational statistics	https://www.youtube.com/watch?v=23QtdnfhBRY

C. Text Book(s)

Ajit K Roy, Applied Computational Biology and Statistics in Biotechnology and Bioinformatics, New India Publishing Agency, 2012.

D. Reference Book(s)

1. Rastogi,S.C. Parag Rastogi, Namita, Bioinformatics Methods andApplications: Genomics Proteomics And Drug Discovery, 3rd Edition, , PHILearning Pvt. Ltd., 2008, ISBN:978-81-203-3595-0.
2. David W mount, Bioinformatics: Sequence and genome analysis, 2nd edition, CBS publishers, New Delhi, 2004, ISBN 978-087969712-9.
3. Manju Bansal, Basic Bioinformatics, Atlantic Publishers &Distributors , 2009, ISBN 978-81-269-1043-4
4. Andreas D. Baxevanis , B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, 2005 ISBN: 978-81-265-2192-0

E. Weblinks

1. https://www.youtube.com/watch?v=kbU_qkVGIc4
2. https://www.youtube.com/watch?v=B7zpLQfo5sQ
3. https://www.youtube.com/watch?v=IaBQBiOID1c

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Microarray and its Applications		
1.1 & 1.2	Introduction to Microarray & Application of Microarray	Explain the microarray, functional genomics and computational tools useful for bioinformatics research	K2
1.3 & 1.4	Data analysis &Functional Genomics	Analyze the biological data and genomics	K3
1.5	Software Tools and Resources for Bioinformatics Research	Identify the molecular evolution and biological data	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.6	Database, Web Resources and Computational Tools useful for Bioinformatics Research	Use and development of computing tools to solve problems and create hypotheses in all areas of biological sciences	K3
2	**Introduction to Proteomics**		
2.1	Bioinformatics Studies in Plants	Discuss the computational statistics and computational biology in bioinformatics	K2
2.2	Computational Biology and Bioinformatics Driven Research in Catfish	Explain the basics of computational biology and bioinformatics driven	K2
2.3	Recent Trends in Fish Genomics	Develop new methodology to comparative genome analysis	K5
2.4	Advances in proteomics, Principles, Methods and Bioinformatics	Demonstrate the steps involved in proteomics analysis	K3
2.5	Expressed Sequence Tags	Explain the principles of expressed sequence Tags	K3
2.6	In silico prediction of SSR and SNP	Discuss the principle of In silico prediction of SSR and SNP	K2
2.7	Chromosomes and nuclear DNA amount to deduce Evolutionary Relationship of the species.	Demonstrate the steps involved in evolutionary relationship of the species	K3
3	**Sequence Analysis through Phylogeny**		
3.1	Molecular Evolution and Phylogenetic analysis	Analyse the evolution and phylogenetic analysis	K4
3.2	Computational Phylogenicity of Biological pathway	Demonstrate the steps involved inphylogenicity of biological pathway	K3
3.3	Plant DNA Barcoding	Explain the basics of plant DNA Barcoding	K2
3.4	Phylogenetic analysis of Microbes using Bioinformatics Tools	List and summarize the types of phylogenetic analysis of microbes using bioinformatics Tools	K1
3.5	Construction of Phylogenetic Tree	Describe the construction of phylogenetic Tree	K2
3.6	Barriers of gene flow and crossability of species in relation to Phylogenic position	Discuss gene flow and crossability of species in relation to Phylogenic position	K2
4	**Applications of Applied Bioinformatics**		
4.1	High Throughput Biomedical Instrumentations and use in Medical Bioinformatics	Define the High Throughput Biomedical Instrumentations and use in medical bioinformatics	K1
4.2	Genome and personalized Medicine	Discuss genome and personalized Medicine	K2
4.3	Computational Toxicology	Calculate the computational toxicology	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.4	Quantum Mechanical Methods applied to accurate in silico Drug designing	Identify the new drug involved in structure bases drug design	K2
4.5	Active Site Prediction	Explain the active site prediction	K2
4.6	Bioinformatics approach in phytoremediation	Discuss the bioinformatics approach in phytoremediation	K2
5	**Advanced Applications of Applied Bioinformatics**		
5.1	Application of Computational statistics and computational Biology in Bioinformatics	Define of computational statistics and computational biology in bioinformatics	K1
5.2	Advances statistical Methods in Bioinformatics	Explain the statistical methods in bioinformatics	K2
5.3	Statistical Tools in Agricultural Bioinformatics	Explain the types of statistical tools in agricultural bioinformatics	K2
5.4	Theory of probability and its application in Bioinformatics	Calculate the theory of probability and its application in bioinformatics	K4
5.5 & 5.6	Data mining and Pattern analysis of molecular data and Text Mining in Bioinformatics	Demonstrate the data mining and Pattern analysis of molecular data and Text mining in bioinformatics	K3
5.7	Current Socio-economic and Environment issues of genetically modified crops	Discuss the socio-economic and environment issues of genetically modified crops	K2
5.8	Ethics and issues of Biotechnologically and Genetically modified Crops.	Discuss the ethics and issues of Biotechnologically and genetically modified crops	K2

4. Mapping Scheme

I20BI5S2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	-	L	-	-	H	H	L	-
CO3	M	H	L	L	L	-	-	-	L	M	-	-	H
CO4	H	H	-	-	M	-	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	M	H	M	M	M	L	M	H	-	H	L	L	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Core IV: Mathematics- Vector Algebra and Calculus

Semester : IV **Course Code : I23BI404**

Credits : 5 **Hours / Week : 6**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Recall the basics of linear algebra involving the definition of matrices and determinants	K1	I
CO2	Explain Cramer's rule- matrix method to solve linear system of equations	K2	I
CO3	Analyse the difference between scalar and vector quantities, types of vectors the basics and applications of vector algebra in solving problems	K4	II
CO4	Determine the fundamentals of differential calculus including functions and limits	K3	III
CO5	Solve problems using the rules of differentiation	K6	IV
CO6	Evaluate problems involving various methods of integration	K5	V

2. A. Syllabus

Unit I - Linear Algebra: Determinants, Matrices **18 Hours**

1.1. Introduction-Determinants, Minors, cofactors,Laplace expansion
1.2. Matrices:Special Matrices-Equality of Matrices-Related Matrices
1.3. A solution of Linear system of equations-Cramer's rule-Matrix Method.

Unit II - Vector Algebra **18 Hours**

2.1. Notation-Equal vectors-Addition and subtraction of vectors
2.2. Commutative and associative laws of addition-Position vectors-Centroid
2.3. Components of vector-Vector products-Distributive Law-Vector or cross product
2.4. Geometrical representation-To express $a \times b$ in the form of a determinant-The area of the triangle.

Unit III - Functions and Limits **18 Hours**

3.1. Constants and Variables-Functions
3.2. Classification of functions-Limit of a function –Some theorems on Limit

3.3. Certain special Limits (results only)-Indeterminant forms -Continuous and discontinuous functions.

UNIT IV – Differentiation **18 Hours**

4.1. Definition-Standard forms(results only)-General theorems on differential coefficients(results only)

4.2. Product rule-Quotient rule-Functions of function rule-Inverse functions

4.3. Hyperbolic functions-Transformations-Parametric functions.

Unit V- Integral Calculus **18 Hours**

5.1. Definite Integral-Methods of Integration

5.2. Integrals of functions containing linear functions of x-Integrals of functions involving $a^2 \pm b^2$.

B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Matrices and Determinants	1. https://www.udemy.com/course/introduction-to-matrices/ 2. https://www.khanacademy.org/math/algebra-home/alg-matrices 3. https://www.khanacademy.org/math/algebra-home/alg-matrices/alg-model-situations-with-matrices/v/data-in-matrices
2	Vector Algebra	1. https://www.khanacademy.org/math/algebra-home/alg-vectors 2. https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:vectors/x9e81a4f98389efdf:vector-add-sub/v/adding-vectors 3. https://www.khanacademy.org/math/linear-algebra/matrix-transformations/linear-transformations/v/vector-transformations
3	Differentiation	1. https://www.open.edu/openlearn/science-maths-technology/introduction-differentiation/content-section-0?intro=1 2. https://www.khanacademy.org/math/differential-calculus#dc-diff-intro 3. https://www.khanacademy.org/math/ap-calculus-ab/ab-differentiation-1-new/ab-2-1/v/newton-leibniz-and-usain-bolt
4	Integral Calculus	1. https://www.khanacademy.org/math/calculus-1/cs1-integrals 2. https://www.khanacademy.org/math/ap-calculus-ab/ab-applications-of-integration-new/ab-8-2/e/analyzing-motion-problems-integral-calc 3. https://www.khanacademy.org/math/old-integral-calculus/integration-techniques

C. **Text Book(s)**

1. B.S.Grewal and J.S.Grewal , "Higher Engineering Mathematics",Khanna Publications,37th Edition. (Unit-I)

   Chapter 2 : 2.1-2.3 and 2.5-2.8
2. Vector Algebra and Analysis(Applications to Analytical Geometry of three dimensions)S.Narayanan,T.K.Manivachagam Pillay,S.Viswanathan(Printers & Publishers), Pvt., Ltd.1986. (Unit II -)

   Chapter 1: Section 1-8

   Chapter 2: Section 1-8
3. Narayanan and T K Manicavachagom Pillay, "Calculus-Volume I", S. Viswanathan (Printers & Publishers) Pvt.,Ltd, Reprint 2011.(Unit I - II & IV)

   Unit II - I Chapter-1: Page No:1-23 .

   Chapter –6: Section 4.1-4.6.

   Unit-IV Chapter – 2 : Section 1-3.14 and 4.3-6.
4. Narayanan and T K Manicavachagom Pillay, "Calculus-Volume II", S. Viswanathan (Printers & Publishers) Pvt., Ltd, Reprint 2011.(Unit V -)

   Chapter-1: Section 1.1-6.3.

D. **Reference Book(s)**

1. Erwin Kreysig, "Engineering Mathematics", 7th Edition, John Wiley, USA, 2001.
2. SG Venkatachalapathy, Allied Mathematics (in single volume), Margham Publications, Chennai, Reprint 2011.

E. **Weblinks**

1. https://www.youtube.com/watch?v=1LubzKrjr68
2. https://www.youtube.com/watch?v=YshfZm99wjk
3. https://www.youtube.com/watch?v=W3JBWKVXq9o

3. **Specific Learning Outcomes (SLO)**

Unit/ Section	Course contents	Learning Outcomes	HBTLTs
1	Linear Algebra : Determinants, Matrices		
1.1	Introduction- Determinants	Define matrices, determinants and recall the properties of determinants	K1
1.2	Minors, cofactors	Determine minors and cofactors in a determinant	K3
1.3	Laplace expansion	Compute the determinant of a square matrix by using Laplace expansion	K3
1.4	Matrices, Special Matrices, Equality of matrices, Related matrices	Explain equal matrices and various types of matrices	K3

Unit/ Section	Course contents	Learning Outcomes	HBTLTs
1.5	A solution of Linear system of equations- Cramer's rule - Matrix Method.	Estimate the solution of linear equations by Cramer's rule	K2
2	**Vector Algebra**		
2.1	Notation-Equal vectors	Recall the representation of a vector	K1
2.2	Addition and subtraction of vectors	Explain addition and subtraction of vectors	K4
2.3	Commutative and associative laws of addition	Discuss the theorems on laws of addition of vectors	K2
2.4	Position vectors-Components of vector	Identify the position vector and components of vector	K2
2.5	Centroid	Determine the position vector of the centroid	K3
2.6	Vector products or cross product -	Estimate the vector product of two vectors	K4
2.7	Distributive Law	Explain the Distributive Law for vectors using vector or cross product	K4
2.8	Geometrical representation-To express $a \times b$ in the form of a determinant	Illustrate the vector product $a \times b$ in the determinant notation	K2
2.9	The area of the triangle	Apply vector product in determining the area of a triangle, parallelogram and quadrilateral	K3
3	**Functions and Limits**		
3.1	Constants and Variables	Recall the terms constant and variable	K1
3.2	Functions	Define a function , domain and range of a function	K1
3.3	Classification of functions	Analyse the different types of functions available	K4
3.4	Limit of a function	Describe the left limit, right limit and limit of a function at a point	K2
3.5	Some theorems on Limit	Discuss some fundamental theorems of limit	K2
3.6	Certain special Limits (results only)	Illustrate some important limits	K3
3.4	Indeterminate forms	Evaluate solution for problems having indeterminate forms using standard rules	K3
3.5	Continuous and discontinuous functions.	Enumerate continuous and discontinuous functions	K1
4	**Differentiation**		
4.1	Definition-Standard forms(results only)	Interpret the meaning of differentiation and discuss the standard forms of differentiation	K3
4.2	General theorems on differential coefficients(results only)	Analyse the theorems on differential coefficients	K4

Unit/ Section	Course contents	Learning Outcomes	HBTLTs
4.3	Product rule, Quotient rule, Functions of function rule	Estimate solutions to the problems using the various rules of differentiation	K4
4.4	Inverse functions, Hyperbolic functions	Apply the formulae for the derivatives of the inverse and hyperbolic functions and their associated integrals.	K3
4.5	Transformations	Develop suitable transformations for differentiation	K3
4.6	Parametric functions.	Evaluate for functions involving parameters	K5
5	**Integral Calculus**		
5.1	Definite Integral	List the integral formulae	K2
5.2	Methods of Integration	Determine the methods of Integration	K3
5.2	Integrals of functions containing linear functions of x	Evaluate the integrals containing linear functions of x	K5
5.3	Integrals of functions involving $a^2 \pm b^2$	Solve integrals involving $a^2 \pm b^2$	K6

4. Mapping Scheme

I20BI404	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	L	M	-	H	M	-	H	H	M	H
CO2	H	M	L	L	L	L	L	-	-	H	H	L	-
CO3	H	M	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.

3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. MadhuBala

Core Prac IV : Octave Programming for Bioinformatics

Semester : IV | **Course Code : I23BI4P4**

Credits : 2 | **Hours/Week 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Analyze the program for correctness and determine/ estimate/ predict the output	K4	1, 4
CO2	Write programs using statistical methods	K1	2, 3, 4, 5
CO3	Sketch the usage of equation solving functions	K3	2, 3, 5
CO4	Demonstrate the applications of 2D and 3D graphs	K3	7
CO5	Quantify the outputs under simulation environment using Octave tools	K4	6, 7
CO6	Formulate the applications of plots in Biological problems	K5	5, 8

2. A. List of Experiments

1). Matrix manipulations
2). Solve system of linear equations
3). Solve quadratic equations
4). Check for Palindrome
5). Generate Fibonacci Numbers
6). Find Binomial Co-efficient
7). 2D and 3D Graphs
8). Subplots

B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Octave-Scientific Programming Language	https://towardsdatascience.com/octave-scientific-programming-language-crash-course-2ab8d864a01d
2.	Matlab for Bio Engineers	https://www.youtube.com/watch?v=wBeWRun2T2c

C. **Reference Book(s)**

1. Conrad Bessant, Darren Oakley, Ian Shadforth, Building Bioinformatics Solutions 2nd Edition, 2014.
2. Svein Linge, Hans Petter Langtangen, Programming for Computations - MATLAB/Octave, 2016.

D. **Web links**

1. https://onlinecourses.nptel.ac.in/noc21_ge10/preview
2. https://www.classcentral.com/course/edx-matlab-and-octave-for-beginners-7376

3. **Specific Learning Outcomes (SLO)**

Ex. No	Course Contents	Learning Outcomes	HBTLT
1	Matrix manipulations	Demonstrate the functions of matrix manipulations	K3
2	To solve system of linear equations	Explain the steps involved in solving linear equations	K2
3	To solve quadratic equations	Practice the steps of quadratic equations	K3
4	To check for Palindrome	Critique the outputs of palindrome	K4
5	To generate Fibonacci Numbers	Develop program for generating Fibonacci series	K5
6	To find Binomial Co-efficient	Analyse the steps of finding Binomial Co-efficient	K4
7	2D and 3D Graphs	Develop new coding for 2D and 3D Graphs	K5
8	Subplots	Propose the strategies for developing subplots	K5

4. Mapping Scheme

I23BI4P4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Rameeza

Allied IV : Molecular Biology & Genetic Engineering

Semester : IV **Course Code : I23BI4Y4**

Credits : 4 **Hours / Week : 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Illustrate DNA replication mechanism in prokaryotes and Eukaryotes	K2	I
CO2	Analyze the functions of the proteins involved in eukaryotic and prokaryotic transcription	K4	II
CO3	Interpret the genetic code	K2	III
CO4	Employ DNA modifying enzymes in gene cloning	K3	IV
CO5	Categorize vectors based on their features	K4	V
CO6	Report on gene libraries and its construction	K6	V

2. A. Syllabus

Unit I - DNA Replication and DNA Repair **12 Hours**

1.1 DNA replication-Various modes of replication-Mechanisms of prokaryotic and Eukaryotic DNA replication-Properties of DNA polymerases-Synthesis ofLeading and lagging strands

1.2 DNA Repair-Photoreactivation, excision repair, post replication repair and SOS repair

Unit II - Transcription **12 Hours**

2.1 RNA polymerase in prokaryotes-Molecular composition and role of each component of RNA polymerase

2.2 Transcription -Transcription in eukaryotes-Transcription in prokaryotes

2.3 Post transcriptional modification -Modification of RNA: 5' CAP formation, 3' end processing polyadenylation – Splicing-RNA Editing

2.4 Nuclear export of mRNA & mRNA stability

2.5 Transcriptional control-Positive control - Negative control

Unit III - Translation **12 Hours**

3.1 The genetic code

3.2 Translation-Translation in Prokaryotes-Translation in Eukaryotes

3.3 Post Translation Modification

Unit IV - Recombinant DNA **12 Hours**

4.1 History and scope of recombinant DNA technology

4.2 DNA modifying enzymes

Unit V - Cloning and expression vectors **12 Hours**

5.1 Characteristics of cloning and expression vectors;

5.2. Plasmid, phages, and cosmid vectors, multipurpose cloning vectors, shuttle vectors, bacterial, yeast, plant and mammalian expression vectors. BACs and YACs.

5.3. DNA cloning strategies

5.4. Preparation of genomic and cDNA libraries

B. Topics for Self Study:

S.No	Topics	Reference
1	Structure of DNA	James D. Watson, Alexander Gann, Tania A. Baker,Michael Levine, Stephen P. Bell, Richard Losick, Molecular Biology of The Gene, Seventh Edition, Pearson, 2017
2	Structure of RNA	James D. Watson, Alexander Gann, Tania A. Baker,Michael Levine, Stephen P. Bell, Richard Losick, Molecular Biology of The Gene, Seventh Edition, Pearson, 2017
3	Homologous Recombination	James D. Watson, Alexander Gann, Tania A. Baker,Michael Levine, Stephen P. Bell, Richard Losick, Molecular Biology of The Gene, Seventh Edition, Pearson, 2017
4	Site Specific Recombination	James D. Watson, Alexander Gann, Tania A. Baker,Michael Levine, Stephen P. Bell, Richard Losick, Molecular Biology of The Gene, Seventh Edition, Pearson, 2017

C. Text Book(s)

1. Gupta. P.K. Cell and Molecular biology. Rastogi Publications, India. 2005. (Unit I - III)

2. Sathyanarayana U, Biochemistry, 3rd Edition. New Central Book Agency(p) Ltd, 1999. (Unit I - III)

3. Jogdand, S.N., Gene biotechnology. Himalaya Publishing House. 2009. (Unit IV-V)

D. Reference Book(s)

1. Roodney Boyer, Concepts in Biochemistry, Brooks/Cole Publishing Co. 1st Edition, 1999.

2. Bernard R, Glick and Jack J. Pastermack, Molecular Biotechnology: Principles and Applications of Recombinant DNA. American Society Microbiology Edition: 3rd, (2003).

3. Brown TA, Gene Cloning, Published by Blackwell Science, 7th Edition. 2001.
4. Primrose SB and RW, Principles of Gene Manipulation, Old, Published by Blackwell, 6th Edition, 2002.
5. Maniatis T, Molecular Cloning. A. Laboratory Manual. CSH Lab. N.Y. (1989).

E. Weblinks:

1. https://www.youtube.com/watch?v=nqG9zsvd1Rk
2. https://www.youtube.com/watch?v=W7z4fDVoUPA
3. https://www.youtube.com/watch?v=c-EBH0tuoI4

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**DNA Replication and DNA Repair**		
1.1	1.1 DNA replication 1.1.1 Various modes of replication 1.1.2 Mechanisms of prokaryotic and eukaryotic DNA replication 1.1.3 Properties of DNA polymerases 1.1.4 Synthesis of Leading and lagging strands	Distinguish between prokaryotic and eukaryotic replication	K4
1.2	1.2 DNA Repair 1.2.1 Photoreactivation, excision repair, post replication repair and SOS repair	Explain photoreactivation Illustrate excision repair mechanism Describe post replication repair	K2 K2 K2
2	**Transcription**		
2.1	2.1 RNA polymerase in prokaryotes 2.1.1 Molecular composition and role of each component of RNA polymerase	Describe the component/subunits of RNA polymerase and its function	K2
2.2	2.2 Transcription 2.2.1Transcription in eukaryotes 2.2.2 Transcription in prokaryotes	Illustrate transcription in prokaryotes and eukaryotes	K2
2.3	2.3 Post transcriptional modification 2.3.1 Modification of RNA: 5' CAP formation, 3' end processing polyadenylation 2.3.2 Splicing 2.3.3 RNA Editing	Inspect the proteins involved in 5' CAP formation, 3' end processing Illustrate splicing mechanism Explain RNA editing and two major reactions responsible for RNA editing	K4 K2 K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2.4	Nuclear export of mRNA & mRNA stability	Analyze the mechanism which protects mRNA from Degradation	K4
2.5	2.5 Transcriptional control 2.5.1 Positive control 2.5.2 Negative control	Distinguish between positive and negative control of gene expression	K4
3	**Translation**		
3.1	The genetic code	Describe the characteristics of genetic code	K2
3.2	3.2 Translation 3.2.1 Translation in Prokaryotes 3.2.2 Translation in Eukaryotes	Illustrate translation in prokaryotes and eukaryotes	K2
3.3	Post Translational Modification	Discuss the post translational modifications	K2
4	**Recombinant DNA**		
4.1	History and scope of recombinant DNA technology	Use recombinant DNA technology for various applications.	K3
4.2	DNA modifying enzymes	Apply DNA modifying enzymes to manipulate genes	K3
5	**Cloning and expression vectors**		
5.1	Characteristics of cloning and expression vectors; plasmid, phages, and cosmid vectors, multipurpose cloning vectors, shuttle vectors, bacterial, yeast, plant and mammalian expression vectors. BACs and YACs.	Analyze the characteristics of cloning and expression vectors Differentiate YAC from BAC	K4 K4
5.2	DNA cloning strategies	Report on steps involved in DNA cloning	K4
5.3	Preparation of genomic and cDNA libraries	Evaluate the importance of gene libraries	K6

4. Mapping Scheme

I20BI4Y4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	L	L	-	L	-	L	-	H	M	H	L
CO2	M	L	L	L	L	L	-	L	-	L	L	-	L
CO3	L	M	M	M	-	L	-	L	L	L	M	M	L
CO4	L	L	L	L	-	L	-	L	L	L	L	M	L
CO5	M	L	L	L	-	L	-	L	-	L	L	-	L
CO6	L	L	L	M	-	L	-	L	L	L	L	L	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Ms. S. Leelavathy

Allied Prac II : Molecular biology and Genetic Engineering Lab

Semester : IV | **Course Code : I23BIYP4**
Credits : 3 | **Hours / Week : 3**

3. Course Outcomes

After completion of this course, the students will be able to:

CO	Course Outcomes	Level	Experiment
CO1	Identify the microbes under the microscope	K2	a1
CO2	Differentiate gram positive bacteria from gram negative bacteria	K4	a2
CO3	Categorize microbes using plating techniques	K4	a3
CO4	Analyze the isolated DNA from buccal and bacterial cell	K3	b1&b2
CO5	Demonstrate agarose gel electrophoresis	K3	b3
CO6	Illustrate the mechanism of Restriction digestion of DNA and southern blot hybridization	K2	b4&b5

4. A. List of Experiments

b. Genetic Engineering

1. Isolation of Genomic DNA and Quantization of DNA
2. Isolation of bacterial plasmid DNA
3. Agarose gel electrophoresis of DNA
4. Restriction digestion of DNA with one restriction enzyme
5. Southern blot hybridization with non-radioactive probe (Demo)

E. Topics for Self-Study:

S.No.	Topics	Web Links
1	Media Preparation	https://bio.libretexts.org/Learning_Objects/Laboratory_Experiments/Microbiology_Labs/Microbiology_Labs_I/01%3A_Media_Preparation
2.	Antimicrobials	https://bio.libretexts.org/Learning_Objects/Laboratory_Experiments/Microbiology_Labs/Microbiology_Labs_I/10%3A_Antimicrobial_Chemicals
3.	PCR	https://learn.genetics.utah.edu/content/labs/pcr/

F. Reference Book(s)

1. Sambrook, J and Green, M. R., Molecular Cloning: A Laboratory Manual, 2012, Fourth Edition, Cold Spring Harbor Laboratory Press.

G. Web links

1. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf 2. https://nptel.ac.in/courses/102/104/102104052/

6. Specific Learning Outcomes (SLO)

Exercises	Course Contents	Learning Outcomes	HBTLT
4	Isolation of Genomic DNA and Quantization of DNA	Design a protocol to isolate the genomic DNA from buccal cells	K5
5	Isolation of bacterial plasmid DNA	Develop methodology to isolate the plasmid DNA from bacteria	K5
6	Agarose gel electrophoresis of DNA	Calculate the MW of the DNA by performing Agarose gel electrophoresis	K4
7	Restriction digestion of DNA with one restriction enzyme	Produce fragments of DNA using restriction enzymes	K3
8	Southern blot hybridization with non-radioactive probe (Demo)	DemonstrateSouthern blot hybridization	K3

7. Mapping Scheme

I20BIYP2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M	L	M	L	L	-	L	L	-	L
CO2	L	L	L	M	L	M	L	L	-	L	L	-	L
CO3	L	L	L	M	L	M	L	L	L	L	L	-	L
CO4	L	L	L	M	L	M	L	L	L	L	L	-	L
CO5	L	L	L	M	L	M	L	L	-	L	L	-	L
CO6	L	L	L	M	L	M	L	L	L	L	L	-	L

L: Low **M: Medium** **H: High**

8. Course Assessment Methods

Direct

5. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
6. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
7. Pre/Post Test, Viva, Report for each Exercise.
8. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M.Gananraj

In Silico Applications for Crop Development

Semester: IV Code: U23EG4A4
Credits : 2 Hours: 2 hours/week

1. Course Outcomes (only five outcomes – unit wise)

CO No.	Course Outcomes	K - Level	Unit
CO1	To comprehend the key concepts of S-L and differentiate the community service and Service-Learning	K2	1
CO2	Discuss the libraries required to construct virtual library databases for green environment	K2	2
CO3	Design a plan for the engagement of students with the community through engaged teaching, research and service	K3	3
CO4	Apply the programming language in developing effective IoTs for sustainable crop development	K3	4
CO5	Analyze the need-based requirements in agriculture development	K4	5

2 a Syllabus

Unit 1

Service-Learning – Definition, difference between community service and service-learning, Principles; Whole Person Education. Identifying Community Needs, Community Partners, Reflection, Reciprocity. Public Dissemination; Understanding of community dynamics. Project Planning Stages and report preparation

Classroom Activity:

i. Group discussion about Civic/Social responsibility (Display of Video/Documentary film (Through this activity Students should recognize civic responsibility of the society)
ii. Conduct a role play/games/drawing to provide problem solving skill and ignites critical thinking.
iii. Group activity to frame questionnaire for identify community needs
iv. Reflection on identify the need of the community (Students go to the community for identify the community needs and reflect their experience)

Unit 2: Biodiversity Management in Agriculture– 12 hrs

Crop improvement –Soil analysis – Fertilizers – Water management through IoTs-Biodiversity of indigenous medicinal plants – Sustainable development of endangered flora and fauna

Classroom Activity:

1. Group activity to study about the plants insect resistance
2. Group discussion/ debate about the needs for sustainable development and management of biodiversity
3. Conduct a role play/games/drawing to create impact on crop management

Unit 3: IoTs and Sensors – 12 hrs

Introduction to IoTs and sensors – Types of Sensors – Applications of Sensors in various fields – Arduino, Raspberry, Types and their applications with limitations – Model development

Classroom Activity:

1. Develop blue print for basic model of the given task
2. Construct basic connectivity using Arduino and Raspberry boards

3. Conduct a role play/games/drawing to provide knowledge about various types of sensors and Arduino boards
Unit 4: Community Engagement
Practicing programming languages for module preparation to identify solutions and working model - Evaluate and justify a method to connect with community members and imbibe the importance of sensors and IoTs-Develop small modules based on the community needs such as sensor buzzer & water management Field Activity 1. Explain the blue print of models that are designed for the community needs 2. Construct/ Demonstrate the working model to the community 3. Evaluate and modify the model after pilot study with community
Unit 5: Community Engagement
Sensor based service for protecting crops from invading of animals-Sustainable improvement in endangered species through developing SOPs-Identify the diseased plants through image analysis Field Activity 1. Explain how to use the model for the crop development 2. Discuss the usage of database for sustainable development with community 3. Demonstrate the usage of image analysis on diseased plants

b. Text Books

1. Introduction to sensors in IoT and cloud computing applications, Ambika Nagaraj (2021)
2. An Advanced Textbook on Biodiversity, K.V. Krishnamoorthy (2018)

c. References

1. Smart sensors at the IoT Frontiers, (2017)

Core V : Structural Bioinformatics And Medicinal Chemistry

Semester : V **Course Code : I23BI505**

Credits : 4 **Hours/ Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Recall the different Level and organization of protein structure	K1	I
CO2	Explain basic principles of experimental methods for the determination of the structure of Macromolecules	K2	I
CO3	Discuss some of the relevant protein, DNA and RNA databases including PDB and associated file formats, data representation and file viewers	K2	II
CO4	Analyze the appropriate tools to predict the secondary and tertiary structure of a protein Sequence of interest	K4	III
CO5	Relate the four key components of ADME properties	K4	IV
CO6	Assess the cell signaling receptors and its role in drug designing.	K6	V

2. A. Syllabus

Unit I - Introduction (Basic concept only) **18 Hours**

1.1. Define Bioinformatics and Structural Bioinformatics
1.2. Fundamentals of Protein, DNA and RNA structure
1.3. Macromolecular structure determination: Crystallography
1.4. Nuclear Magnetic Resonance
1.5. Electron Microscopy
1.6. Molecular Visualization

Unit II - Data representation, Structural Databases and Validation Servers **18 Hours**

2.1 Data Representation:PDB Format
2.2. Structural Databases: PDB, NDB, SCOP Database, CATH domain structure database
2.3 Other structure Databases: CSD, PDBsum, MolProt, PubChem, ChEMBL, ZINC Database, ChemBank
2.4. Structure Validation Server:SAVES- Ramachandran Plot, WHAT_IF server, ProSA, Naccess

Unit III - Methods of Protein Structure Prediction and Visualization

18 Hours

3.1. Methods of Protein structure prediction: Fold Recognition Method (Threading), Ab-initio Method
3.2. Homology Modeling, CASP and CAFASP
3.3. Visualization tools: PyMol, SPDBV, Chimera

Unit IV - Basics of Medicinal chemistry **18 Hours**

4.1. Basics and properties of small molecules
4.2. Other properties influence small molecules: Lipinski rule of 5,
4.3. Pharmacophore, Ames Mutagenicity
4.4. QSAR, 3D QSAR

Unit V - Drug target principles & Molecular visualization **18 Hours**

5.1. Drug Target principles: Drug action that affects the structure of cell membranes and walls - receptors and messengers
5.2. Chemical nature of the binding of ligands to receptors
5.3. Structure and classification of receptors
5.4. Ligand-response relationships, ligand-receptor theories, drug action and design
5.5. Enzymes: active site and catalytic action, regulation of enzyme activity, specific nature of enzyme action.
5.6. Mechanism of enzyme action
5.7. Enzyme Kinetics
5.8. Enzyme inhibitors, transition state inhibitors, enzyme and drug design
5.9. Examples of drugs used as enzyme inhibitors
5.10. Enzymes and drug resistance

B. Topics for Self Study:

S.No	Topics	References/Weblinks
1	Computers in Medicinal chemistry	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
2	Drug Discovery: Finding a Lead	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
3	Drug Design: Optimizing target interactions	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
4	Drug Design: Optimizing access to the target	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
5	Getting the drug to market	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.

C. Text Book(s)

1: JinXiong, Essential Bioinformatics, Cambridge University Press 2006.
2: Manju Bansal, Basic Bioinformatics, Atlantic Publishers & Distributors, 2009.
3: Fundamentals of Bioinformatics, Harisha.S, 2007.

D. Reference Book(s):

1: Phillip E, Brurne, HelgeWeissig, Structural Bioinformatics, A John wiley & Sons Publications, 2011.
2: David M, Bioinformatics: sequence and genome analysis, Cold Spring Harbor Laboratory, 2004.
3: JinXiong, Essential Bioinformatics, Cambridge University Press 2006.
4: Rastogi RS, Bioinformatics concepts, skills & applications, Eastern Economy Edition 2008.
5: Thomas Hamelrcyck, Mardia KV, Bayesian methods in Structural Bioinformatics, Springer 2012.
6: Johann Gasteiger, Chemoinformatics: A Text book, Thomas Engel 2006.

E. Weblinks

1. https://www.youtube.com/watch?v=tdwdtrnWhrw
2. https://www.youtube.com/watch?v=SEXT6Pulxrc
3. https://www.youtube.com/watch?v=9lWrNuUzP4A

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction (Basic concept only)**		
1.1	**Introduction**: Define Bioinformatics and Structural Bioinformatics	RecallBioinformatics Define structural bioinformatics	K1
		Explain the role of bioinformatics in structure determination	K2
1.2.	Fundamentals of Protein, DNA and RNA structure	Relate the structure and function ofmacromolecules	K4
		Name the types of protein, DNA and RNA	K1
1.3	Macromolecular structure determination: Crystallography	Discuss the macromolecular structure determination methods	K2
		Utilize crystallographic diffraction data analysis to determine the macromolecular structures.	K3
1.4	Nuclear Magnetic Resonance	Define the principle of NMR	K1
		Relate NMR with ESR	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.5	Electron Microscopy	Describe Electron microscopy Applications of Electron microscope in different fields.	K2 K4
1.6	Molecular Visualization	Categorize the molecular visualization tools Uses of molecular Visualization tools	K4 K3
2	**Data representation, Structural Databases and Validation Servers**		
2.1	**Data Representation:** PDB Format	Define the molecular structure file format	K2
2.2	**Structural Databases**: PDB, NDB, SCOP Database, CATH domain structure database	List out the Structural databases Review the attributes of structural databases	K1 K2
2.3	**Other structure Databases:** CSD, PDBsum, MolProt, PubChem, ChEMBL, ZINC Database, ChemBank	Name the small molecule databases Explain the importance of small molecule database Inspect the characteristics of small molecule structure	K1 K2 K4
2.4	**Structure Validation Server**: SAVES- Ramachandran Plot, WHAT_IF server, ProSA, Naccess	Explain the importance of Ramachandran plot in structure validation Validate molecular structures	K2 K6
3	**Methods of Protein Structure Prediction and Visualization**		
3.1	**Methods of Protein structure prediction:** Fold Recognition Method (Threading), Ab-initio Method	Distinguish between experimentally determined structure and theoretically predicted structure Employ different methods for predicting unknown protein structure	K4 K3
3.2	Homology Modeling, CASP and CAFASP	Describe Homology modeling Categorize the different homology modeling softwares	K2 K4
3.3	**Visualization tools:**PyMol, SPDBV, Chimera	Recall knowledge about molecular visualization Illustrate the visualization tools Demonstrate the various depiction of protein structure	K1 K2 K3
4	**Basics of Medicinal chemistry**		
4.1	**Basics of Medicinal chemistry:** Basics and properties of small molecules	List out the properties of small molecules Application of small molecules in medicinal chemistry	K1 K3
4.2	**Other properties influence small molecules:** Lipinski rule of 5, ADMET properties	Define Lipinski rule of 5 and ADMET Explain the druggability guidelines Analyze the lead compounds to identify a potential drug candidate.	K1 K2 K4
4.3	**Pharmacophore, Ames Mutagenicity**	Define pharmacophore List the free online servers for small molecule toxicity prediction Ligand based drug designing using pharmacophore approach	K1 K1 K3

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.4	**QSAR, 3D QSAR**	Define QSAR Explain the steric property of molecules	K1 K2
5	**Drug target principles & Molecular visualization**		
5.1	**Drug Target principles:** Drug action that affects the structure of cell membranes and walls - receptors and messengers	Discuss the major groups of intracellular-and membrane-bound receptors Differentiate a receptor from a drug Report on signal transduction	K2 K4 K6
5.2	chemical nature of the binding of ligands to receptors	Demonstrate the receptor-ligand interaction in alteration of biochemical actvity	K3
5.3	structure and classification of receptors	Categorize receptors Assess the functions of different receptors	K4 K6
5.4	ligand-response relationships, ligand-receptor theories, drug action and design	Theorize ligand-receptor interaction Interpret the possible ligand interactions with receptors	K4 K6
5.5	**Enzymes:** active site and catalytic action, regulation of enzyme activity, specific nature of enzyme action.	Differentiate active site from catalytic site Propose the activity and functions of an enzyme Compare the significance of active site and catalytic site in drug designing.	K4 K5 K6
5.6	mechanism of enzyme action	Apply the lock and key mechanism in ligand designing Analyze the factors affecting enzyme substrate complex formation	K3, K4
5.7	Enzyme Kinetics	Define enzyme kinetics Applications of Michaelis-Menten equation Assess the importance of Michaelis-Menten equation	K1 K3 K6
5.8	Enzyme inhibitors, transition state inhibitors, enzyme and drug design; Examples of drugs used as enzyme inhibitors	Discuss the steps involved in drug discovery Demonstrate enzyme inhibitor interaction Distinguish between enzyme inhibitors and transition state inhibitors	K2 K3 K4
5.9	Enzymes and drug resistance	Define drug resistance Explain different mechanism of drug resistance Investigate the influence of enzymes in drug resistance and drug metabolism	K1 K2 K6

4. Mapping Scheme

I20BI505	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	L	M	L	L	-	L	L	H	M	M	M
CO2	H	L	L	M	L	L	-	L	L	H	M	M	M
CO3	H	L	L	M	L	L	-	L	L	H	M	M	M
CO4	H	H	M	H	M	L	-	L	L	H	H	M	M
CO5	M	M	H	M	L	-	-	-	-	H	-	M	-
CO6	H	H	M	M	M	L	L	M	-	H	H	M	L

L: Low M: Medium H: High

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Jebastin

CORE VI : PROGRAMMING IN PERL AND PYTHON

Semester : V **Course Code : I23BI506**

Credits : 4 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Reiterate the concepts of programming language and Test loops and control structures	K2 &K4	I
CO2	Experiment with file handling and regular expressions	K4	II
CO3	Design applications with string handling functions	K5	II
CO4	Analyse the basic concepts of Python Programming	K4	III
CO5	Construct Tuples, Dictionaries and Lists and Object Oriented Programming concepts	K6	IV
CO6	Create applications in BioPerl and Biopython	K5	V

2. A. Syllabus

Unit I - Introduction to PERL **18 Hours**

1.1. Variable Types
1.2. Operators
1.3. Control structures - If statements – if-else – if-elsif – if-elsif-else
1.4. While loop – until loop –unless for loop – foreach loop – scoping of variables.
1.4. Arrays
1.5. Hash functions
1.6. Subroutines; using system command;

Unit II - PERL variables , File Handling and String Handling **18 Hours**

2.1. Basic Input output, special variable @ ARGV
2.2. File Handles and Tests
2.3. Directory Operations
2.4. Important functions (split, index, substr, chomp, length, reverse, shift, sort)
2.5. Regular expressions
2.6. Pattern, Matching Operators

Unit III - Introduction to Python **18 Hours**

3.1. Introduction Python Comments, Identifiers, Keywords, Variables, Standard Data Types

3.2. Operators ,Control Statements, Iteration while Statement

3.3. Input from Keyboard

3.4. Introduction to Functions ,Built-in Functions, User Defined Functions, Recursive Function, Strings ,Lists

Unit IV - Tuples, Dictionaries, Files and Objected Oriented Programming Concepts **18 Hours**

4.1 Tuples , Dictionaries

4.2 Files, Text Files, Directories, Exceptions, Exceptions with Arguments, User-Defined Exceptions

4.3 Object-oriented Programming Overview , Class Definition,Creating Objects, Objects as Arguments, Objects as Return Values

4.4 Built-in Class Attributes, Inheritance, Method Overriding

4.5 Data Encapsulation ,Data Hiding

Unit V - Introduction to BioPERL and Biopython **18 Hours**

5.1. **BioPERL:** Introduction to BioPERL, BioPERL objects

5.2. Searching and matching sequences in PERL, BLAST parsing, Handling PDB files

5.3. Sequence retrieval, Alignments

5.4. **Biopython** :Parsing DNA Data Files: FASTA Files – Genbank Files, Sequence Alignment: Alphabets , Matching Sequences

5.5 Simple Alignments , Numerical Sequence Alignment , Clustering: K-means clustering.

B. Topics for Self Study

S.No	Topics	Web links
1	Calling Bioperl functions from MatLab	https://www.mathworks.com/help/bioinfo/ug/calling-bioperl-functions-from-matlab.html
2	Web development and PERL	https://www.youtube.com/watch?v=oAkasBMJJ18
3	PERL Web programming	https://www.youtube.com/watch?v=266P43Nk4vk
4	Python Random Module	https://www.w3schools.com/python/module_random.asp
5	cMathModule	https://www.w3schools.com/python/module_cmath.asp

C. Text Book(s)

1. Simon Cozens, Peter Wainwright, Beginning Perl, Wrox Press, 2000.(Unit I &II)
2. https://www.perl.org/books/beginning-perl/ (Unit I &II)
3. James Tisdall, Beginning Perl for Bioinformatics, O'Reilly Media, Inc., 2001(Unit-V)
4. Balagurusamy, E, Introduction to Computing and Problem Solving using Python, Tata McGraw Hill Education Pvt Ltd, Ist Edition, 2016. (For units from III to IV)
5. Jason M Kinser, "Python for Bioinformatics", Jones and Bartlett publishers, 1st Edition 2009. (For Unit V - : Chapters 6, 7, 23 and 17 only)

D. Reference Book(s)

1. Wall,L, Christiansen.T and Orwant,J. Programming Perl, 3rd Edition, O'Reilly, 2000.
2. Tisdall.J, Mastering Perl for Bioinformatics, O'Reilly, 2003.
3. Rex A. Dwyer, Genomic PERL, Cambridge Univ. Press, UK, 2003.
4. Harshawardhan P. Bal, PERL programming for Bioinformatics, Tata McGraw-Hill, NewDelhi, 2003.
5. htttp://bioperl.org
6. Balagurusamy, E, Introduction to Computing and Problem Solving using Python, Tata McGraw Hill Education Pvt Ltd, Ist Edition, 2016. (For units from I to IV)
7. Jason M Kinser, "Python for Bioinformatics", Jones and Bartlett publishers, 1st Edition 2009. (For Unit V - : Chapters 6, 7, 23 and 17 only)
8. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
9. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
10. Lutz Mark, Learning Python, O'Reilly, 5th Edition, 2015.

E. Weblinks

1. https://www.youtube.com/watch?v=zPpTd3MaWvA
2. https://www.youtube.com/watch?v=ELp9ytLjupE
3. https://www.youtube.com/watch?v=1AErcVrLpyQ
4. https://nptel.ac.in/courses/106/106/106106182/
5. https://onlinecourses.nptel.ac.in/noc21_cs67/preview
6. https://nptel.ac.in/courses/106/106/106106212/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to PERL**		
1.1	Variable Types	Apply variable types in PERL scripts	K3
1.2	Operators	Demonstrate various operators	K3
1.3	Control structures	Recall control structure to write scripts	K1
1.4	Arrays	Practice lists and arrays	K3
1.5	Hash functions	Demonstrate the use of hash functions to deal with key-value pair	K3
1.6	Subroutines using system commands	Explain the use of subroutines in PERL script	K2
2	**PERL variables , File Handling and String Handling**		
2.1	Basic Input output, special variable @ ARGV, Command line Arguments	Revise command line arguments	K5
2.2	File Handles and Tests	Build applications with Files and directories	K5
2.3	Directory Operations	Create directories via PERL script	K5
2.4	Important functions (split, index, substr, chomp, length, reverse, shift, sort)	Construct applications with string handling	K5
2.5	Regular expressions	Apply regular expressions in PERL scripts	K3
2.6	Pattern, Matching Operators; Standard Modules	Integrate console application with pattern matching	K5
3	**Introduction to Python**		
3.1	Introduction Python Comments, Identifiers, Keywords, Variables, Standard Data Types	Recall the basics of programming languages	K1
3.2	Operators ,Control Statements, Iteration while Statement	Relate Control and Iterative Statements	K4
3.3	Input from Keyboard	Construct programs by reading inputs from the keyboard	K3
3.4	Introduction to Functions ,Built-in Functions, User Defined Functions, Recursive Function, Strings ,Lists	Tell the basics of functions and its types Summarize the applications of built-in-functions	K1 & K2
4	**Tuples, Dictionaries, Files and Objected Oriented Programming Concepts**		
4.1	Tuples, Dictionaries	Describe the basics of Tuples and write programs using Tuples Explain the working principles of Dictionaries with examples	K1&K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.2	Files, Text Files, Directories, Exceptions, Exceptions with Arguments, User-Defined Exceptions	Execute programs using Files and Directories Develop programs with User-defined exceptions	K3&K5
4.3	Object-oriented Programming Overview	Summarize the basics of Object Oriented Programming	K2
4.4	Built-in Class Attributes, Inheritance, Method Overriding	Theorize the built-in class attributes	K2
4.5	Data Encapsulation ,Data Hiding	Recall data encapsulation in Python and apply data hiding concepts	K1 & K3
5	**Introduction to BioPERL and Biopython**		
5.1	Introduction to BioPerl, BioPerl objects	Explain BioPerl objects	K2
5.2	Searching and matching sequences in PERL, BLAST parsing, Handling PDB files	Build scripts with BioPerl packages	K5
5.3	Sequence retrieval, Alignments	Prepare scripts to retrieve sequences from external databases such as Genbank and to console application to display sequences with alignments	K5
5.4	Parsing DNA Data Files	Test parsing PDB files	K5
5.5	Simple Alignments , Numerical Sequence Alignment , Clustering: K-means clustering.	Describe simple sequence alignments and Experiment the biological sequences with k-means clustering	K2 & K4

4. Mapping Scheme

I20BI506	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	H	L	M	H	-	-	H	M	H	H	-	L
CO2	H	H	H	M	H	M	-	H	-	H	H	L	M
CO3	H	H	H	H	H	L	L	H	L	H	H	L	H
CO4	H	H	H	H	H	L	L	H	L	H	H	M	H
CO5	H	H	H	H	H	H	-	H	-	H	H	H	H
CO6	H	H	H	H	H	H	H	H	H	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core Prac VI : Programming in PERL and Python Lab

Semester : V **Course Code : I23BI5P6**

Credits : 2 **Hours / Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Develop scripts using arrays	K4	a1, a2, a3, a4, a5, a6
CO2	Compose applications with file handling with string handling functions	K5	a7,a8,a9
CO3	Construct perl scripts using built-in functions	K5	a10,a11,a12,a13,a14,a15
CO4	Create simple programs in Python for real world problems	K5	b1,b2
CO5	Evaluate programs using classes and objects and construct programs using tuples, lists and dictionaries	K6&K5	b3,b4,b5,b6,b7, b8,b9,b10
CO6	Analyze biological sequences with biopython modules.	K4	b11, b12,b13, b14, b15

2. A. List of Experiments

a. PERL

a1. Write a PERL script to print the elements of an array
a2. Write a PERL script to take an element off the end of an array
a3. Write a PERL script to take an element off the beginning of an array
a4. Write a PERL script to reverse an array
a5. Write a PERL script to get the length of an array
a6. Write a PERL script to insert an element at a random position in an array
a7. Write a PERL script to convert DNT to RNA using Subroutines
a8. Write a Perl script to Concatenate two strings using subroutines
a9. Write a Perl script to convert DNA to RNA
a10. Write a Perl script to calculate the reverse complement of a DNA sequence
a11. Write a Perl script for Searching for Motif in a protein sequence
a12. Write a Perl script for determining frequency of nucleotide in a sequence file
a13. Write a Perl script to find the percentage of hydrophobic amino acids in a sequence
a14. Write a Perl script to find the percentage of G and C content in a DNA sequence
a15. Write a Perl script to append ATGC to a DNA sequence using subroutines

b. PYTHON

b1. Write a Python program to check largest among the given three numbers.
b2. Write a Python function to display Fibonacci sequence using recursion.
b3. Write a Python program to find the duplicate characters in a given string.
b4. Write a Python program to demonstrate string functions and operations.
b5. Write a Python program for list functions and operations.
b6. Write a Python program to print a tuple whose values are even numbers in the given tuple.
b7. Write a Python program to catch a Divide-by-Zero exception.
b8. Write a Python program to write data in a file for both write and append modes.
b9. Write a Python program that defines the class name Employee, define any two sub-classes using Employee.
b10. Write a Python program to demonstrate inheritance and method overriding.
b11. Write a Python program to perform basic operations on Sequences.
b12. Write a Python program to perform complement and reverse complement operations on given sequences.
b13. Write a python program to parse sequence from FASTA and Genbank file formats.
b14. Write a python program to perform various alignments on DNA and RNA sequences.
b15. Write a Python program that takes the protein sequence from the PDB (download the FASTA file manually), and writes a corresponding UniProt file.

B. Topics for Self Study

Topics	Web links
Bigdata in Bioinformatics	https://www.researchgate.net/publication/314979420_Big_Data_in_Bioinformatics
Cloud in Bioinformatics	https://www.nature.com/articles/nrg.2017.113
PyGui and PySide Frameworks	https://blog.resellerclub.com/the-6-best-python-gui-frameworks-for-developers/
Biopython	https://disi.unitn.it/~teso/courses/sciprog/python_biopython_exercises.html

C. Text Book(s)

1. James Tisdall, Beginning Perl for Bioinformatics, O'Reilly Media, Inc., 2001
2. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
3. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Lutz Mark, Learning Python, O’Reilly, 5th Edition, 2015.
5. Lutz Mark, Programming Python, O’Reilly, 4th Edition, 2013.

D. Weblinks

1. https://www.udemy.com/course/perltutorial/
2. https://wanglab.hosted.uark.edu/LearningPerl/www.unix.org.ua/orelly/perl/learn/examples/index.htm
3. http://www.cs.nott.ac.uk/~pszqiu/Teaching/SWTs/Perl-Exercise.htm
4. https://stuff.mit.edu/iap/perl/exercises.html
5. https://perl-begin.org/exercises/
6. https://nptel.ac.in/courses/106/106/106106182/
7. https://nptel.ac.in/courses/106/107/106107220/

3. Specific Learning Outcomes (SLO)

Exercises	Course Contents	Learning Outcomes	HBTLT
	Perl		
a1	Write a PERL script to print the elements of a array	Develop scripts to print array elements	K5
a2	Write a PERL script to take an element off the end of an array	Perform deletion from array	K3
a3	Write a PERL script to take an element off the beginning of an array	Experiment deleting the first element of array	K4
a4	Write a PERL script to reverse an array	Formulate reversing of array	K5
a5	Write a PERL script to get the length of an array	Calculate the length of array	K4
a6	Write a PERL script to insert an element at a random position in an array	Test inserting element at random position in array	K4
a7	Write a PERL script to convert DNA to RNA using Subroutines	Apply subroutine concept in script	K3
a8	Write a Perl script to Concatenate two strings using subroutines	Use BioPerl modules	K3
a9	Write a Perl script to convert DNA to RNA	Apply built-in functions	K3
a10	Write a Perl script to calculate the reverse complement of a DNA sequence	Test string handling functions	K4
a11	Write a Perl script for Searching for Motif in a protein sequence	Practice with pattern matching operators	K3
a12	Write a Perl script for determining frequency of nucleotide in a sequence file	Use loops in scripts	K3
a13	Write a Perl script to find the percentage of hydrophobic amino acids in a sequence	Employ searching algorithms in scripts	K3
a14	Write a Perl script to find the percentage of G and C content in a DNA sequence	Integrate scripts with BioPerl modules	K5
a15	Write a Perl script to append ATGC to a DNA sequence using subroutines	Construct scripts with subroutines	K5

Exercises	Course Contents	Learning Outcomes	HBTLT
PYTHON			
b1	Write a Python program to check largest among the given three numbers.	Construct programs using Control Structure	K5
b2	Write a Python function to display Fibonacci sequence using recursion.	Apply Recursion in function definitions.	K3
b3	Write a Python program to find the duplicate characters in a given string	Apply String Handling Mechanisms	K3
b4	Write a Python program to demonstrate string functions and operations.	Apply string functions and operations	K3
b5	Write a Python program for list functions and operations.	Apply List functions and its operations	K3
b6	Write a Python program to print a tuple whose values are even numbers in the given tuple.	Apply List functions and its operations	K3
b7	Write a Python program to catch a Divide-by-Zero exception.	Apply Exception Handling Mechanisms	K3
b8	Write a Python program to write data in a file for both write and append modes.	Construct a file for reading and writing operations	K5
b9	Write a Python program that defines the class name Employee, define any two sub-classes using Employee.	Construct Programs using classes and objects	K5
b10	Write a Python program to demonstrate inheritance and method overriding.	Apply Inheritance	K3
b11	Write a Python program to perform basic operations on Sequences.	Demonstrate basic operations on Sequences	K3
b12	Write a Python program to perform complement and reverse complement operations on given sequences.	Apply complement and reverse operations on Sequences	K3
b13	Write a python program to parse sequence from FASTA and Genbank file formats.	Construct sequences using FASTA and GENBANK	K5
b14	Write a python program to perform various alignments on DNA and RNA sequences.	Analyse DNA and RNA sequences	K4
b15	Write a Python program that takes the protein sequence from the PDB (download the FASTA file manually), and writes a corresponding UniProt file.	Analyse protein sequences	K4

4. Mapping Scheme

I20BI5P6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	M	H	H	L	-	H	M	H	H	M	L
CO2	H	H	H	H	H	H	-	H	M	H	H	H	H
CO3	H	H	H	H	H	H	M	H	M	H	H	H	H
CO4	H	H	H	H	H	H	H	H	L	H	H	H	H
CO5	H	H	H	H	H	H	H	H	L	H	H	H	H
CO6	H	H	H	H	H	H	H	H	H	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core Prac V : Advanced Bioinformatics Lab-I

Semester : V | **Course Code : I23BI5P5**
Credits : 2 | **Hours/Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Interpret the outputs from basic structure prediction tools	K3	2
CO2	Generate the required information from structural database	K2	1
CO3	Examine various protein visualizing software	K4	5
CO4	Compare the various gene manipulation tools	K5	4
CO5	List the various secondary structure prediction and validating servers	K2	2
CO6	Evaluate the phylogeny of the given sequences	K6	3

2. A. List of Experiments

1. Retrieve a Protein Sequence from UniProtKBand analyse the physio chemical and biological properties of the given protein sequence and perform the following
   (i) Protein Primary Structure Analysis—ProtParam
   (ii) Secondary Structure Prediction Using SOPMA and PSIPRED
2. Predict the protein Tertiary Structure Prediction by Homology ModellingUsingSwissModel and perform the following analysis.
   (i) Protein Tertiary Structure Analysis –RAMPAGE
   (ii) Protein Structure Analysis Using SAVeS
   (iii) Protein Tertiary Structure Prediction by Threading (Fold Recognition)-Phyre2 server.
3. Perform multiple sequence alignment and construct a phylogenetic tree using MEGA.
4. Perform various sequence manipulation tools for the given sequence and analyze the results.
   (i) Restriction mapping-NEBcutter
   (ii) Gene prediction- ORF find
5. Visualize the secondary structure of the proteins using
   (i) Pymol
   (ii) Rasmol

B. Topics for Self Study:

S. No	Topics	Web links
1.	Sequences and Genomic Features 1: Molecular Bio Primer	https://www.coursera.org/lecture/genomic-tools/sequences-and-genomic-features-1-molecular-bio-primer-aN4oD
2.	Bioinformatics: Introduction and Methods	https://www.coursera.org/learn/bioinformatics-pku

C. Reference Book(s)

Baxevanis, A.D. and Francis Ouellellette B.F, Bioinformatics –a Practical Guide to the Analysis of Genes and Proteins , Wiley India Pvt Ltd .2009.

D. Weblinks

1. https://www.youtube.com/watch?v=UAF6ggMHoGE
2. https://www.youtube.com/watch?v=Fs_nJKQ8i6E

3. Specific Learning Outcomes (SLO)

Ex. No	Course Contents	Learning Outcomes	HBTLT
1	Retrieve a Protein Sequence from UniProtKBand analyse the physio chemical and biological properties of the given protein sequence and perform the following i. Protein Primary Structure Analysis—ProtParam	Analyse the physio chemical properties of the given sequences	K4
	ii. Secondary Structure Prediction Using SOPMA and PSIPRED	Demonstrate the secondary structure for the given sequence	K3
2	Predict the protein Tertiary Structure Prediction by Homology Modelling Using SwissModel and perform the following analysis. i. Protein Tertiary Structure Analysis – RAMPAGE	Quantify the better model based on the score Evaluate the predicted structure based on Ramachandran plot	K4 K6
	ii. Protein Structure Analysis Using SAVeS	Justify the predicted protein structure model	K6
	iii. Protein Tertiary Structure Prediction by Threading (Fold Recognition)-Phyre2 server.	Build novel protein structures for the given sequence	K5
3	Perform multiple sequence alignment and construct a phylogenetic tree using MEGA	Critique the given sequence based on phylogenetic tree	K4

Ex. No	Course Contents	Learning Outcomes	HBTLT
4	Perform various sequence manipulation tools for the given sequence and analyze the results i. Restriction mapping-NEBcutter	Catalogue the number of restriction sites in the given sequence	K4
	ii. Gene prediction- ORF find	Categorize the ORF for each frame	K4
5	Visualize the secondary structure of the proteins using i. PyMol ii. RasMol	Integrate the best model through proper structure and score using visualization	K5

4. Mapping Scheme

I20BI5P5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Jebastin

Elective I : Biophysics

Semester : V | **Course Code : I23BI5:A**

Credits : 3 | **Hours/Week :4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Underline the basics of physiochemical properties of atoms and bonds	K1	I
CO2	Employ the separation techniques for biomolecule purification	K3	II
CO3	Describe the basics of crystal system and bravis lattice	K2	III
CO4	Illustrate the methodology of X-ray diffraction	K2	IV
CO5	Theorize the steps involved in NMR spectroscopy	K4	IV
CO6	Propose the importance of optimization of biomolecule	K5	V

2. A. Syllabus

Unit I - Laws of Physics and Chemistry **15 Hours**

1.1. Introduction - Quantum Mechanics
1.2. The Electronic Structure of Atoms
1.3. Molecular Orbitals and Covalent Bonds
1.4. Molecular Interactions - Strong interactions, Weak interactions
1.5. Stereochemistry and Chirality -Entropy -Enthalpy -The free energy of a system.

Unit II - Biophysical Techniques **15 Hours**

2.1. Chromotography-Introduction
2.2. Principles, Process and Applications of Thin layer chromatography
2.3. Column chromatography - Ion exchange and Affinity Chromatography, HPLC.
2.4. Introduction to Electrophoresis, Uni Directional and 2D Electrophoresis
2.5. Introduction UV Visible spectroscopy
2.6. Introduction NMR and MALDI-TOF.

Unit III - X-ray crystallography **15 Hours**

3.1. Crystal and symmetries
3.2. Crystal system, Point groups and space group
3.3. Growth of crystal of Biological molecule
3.4. X-ray diffraction, X-ray data collection, Structure solution, refinement of the structure.

Unit IV - NMR Spectroscopy **15 Hours**

4.1. Introduction to NMR
4.2. Basic principle of NMR
4.3. NMR Theory and experiments, classical description of NMR
4.4. NMR parameter, Nuclear Overhauser Effect
4.5. NMR applications in the field of Medicine.

Unit V - Molecular structure and modeling **15 Hours**

5.1. Introduction- Nucleic acid structure, Protein structure
5.2. Generating the model, Building the protein structure and nucleic acid structure
5.3. Displaying and altering the generated model, optimizing the model

B. Topics for Self Study:

S.No	Topics	Weblink
1	Forces in protein folding	https://nptel.ac.in/courses/104/102/104102009/
2	Thermodynamics of protein unfolding	https://nptel.ac.in/courses/104/102/104102009/
3	Infrared spectroscopy of proteins	https://nptel.ac.in/courses/104/102/104102009/
4	Biological dynamics and rate equations	https://onlinecourses.nptel.ac.in/noc20_ph02/preview

C. Text Book(s)

1. VasanthaPattabhi and N.Gautham, Biophysics, Narosa Publishing house, 2002. (Unit I - -V)

D. **Reference Book(s)**

1. Thomas. E. Creighton, Proteins Structures and Molecular Properties Freeman and Company, 1993.
2. Cantor and Schimmel, Biophysical Chemistry Part II Techniques for the study of biological structure and function, Freeman and Company,2003.
3. Thomas M Devlin,Textbook of Biochemistry ,Wiley LISS Fifth edition,2010.
4. Stephen Neidle, Nucleic Acid Structure and Recognition, Oxford University Press, 2002
5. Leonard Banaszak, Foundations of Structural Biology, Academic Press,2000.
6. Philip E. Bourne, Structural Bioinformatics,John Wiley & sons, 2011.

E. **Weblinks**

1. https://www.youtube.com/watch?v=0FBZFhwJgp8
2. https://www.youtube.com/watch?v=2e9YWygGeto
3. https://www.youtube.com/watch?v=nnVGa8OjkFo

3. **Specific Learning Outcomes (SLO)**

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Laws of Physics and Chemistry**		
1.1 & 1.2	Introduction - Quantum Mechanics- The Electronic Structure of Atoms	Explain the basics of Bohr atom	K2
1.3	Molecular Orbitals and Covalent Bonds	Discuss the pure and hybrid atomic orbitals	K2
1.4	Molecular Interactions-Strong interactions -Weak interactions	List and summarize the types of strong and weak interactions	K1
1.5	Stereochemistry and Chirality -Entropy -Enthalpy -The free energy of a system	Describe the entropy, enthalpy and free energy of a system	K2
2	**Biophysical Techniques**		
2.1 & 2.2	Chromatography-Introduction, Principles, Process and Applications of Chromatography	Explain the basics of chromatography	K2
		Summarize the applications of chromatography	K2
2.3	Thin layer chromatography, Column chromatography -Ion exchange and Affinity Chromatography, HPLC	Explain the principles of TLC and Column chromatography	K3
		Develop new methodology to extract the desired product from biological samples	K5
2.4	Introduction to Electrophoresis, Uni Directional and 2D Electrophoresis,	Critique the applications of electrophoresis for solving biological problems	K2
2.5 & 2.6	Introduction UV Visible spectroscopy, Introduction NMR and MALDI-TOF.	Explain the principles of spectroscopy and NMR	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3	**X-ray crystallography**		
3.1	Crystal and symmetries	Define the basics of crystals and symmetries	K1
3.2	Crystal system, Point groups and space group	Explain the types of crystal system and their arrangements	K2
3.3	growth of crystal of Biological molecule		
3.4	X-ray diffraction, X-ray data collection, Structure solution, refinement of the structure	Discuss the principle of X-ray diffraction	K2
		Sketch the steps involved in X-ray diffraction	K3
4	**NMR Spectroscopy**		
4.1 & 4.2	Introduction to NMR, Basic principle of NMR	Describe the basics of NMR	K2
4.3	NMR Theory and experiments, classical description of NMR,	Define the theories and classical description of NMR	K2
4.4	NMR parameter, Nuclear Overhauser Effect	Analyse the parameters of NMR	K4
4.5	NMR applications in the field of Medicine	Employ the applications of NMR on Medicine	K3
5	**Molecular structure and modeling**		
5.1	Introduction- Nucleic acid structure, Protein structure	Recall and explain the structures of nucleic acids and proteins	K1
5.2	Generating the model, Building the protein structure and nucleic acid structure	Demonstrate the steps involved in protein structure	K3
5.3	Displaying and altering the generated model, optimizing the model	Modify the steps and evaluate the modeled protein structure	K5

4. Mapping Scheme

I20BI5:1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	L	L	M	-	H	M	-	H	H	M	H
CO2	M	H	L	L	L	L	L	-	-	H	H	L	-
CO3	M	H	L	L	M	-	L	-	-	M	-	-	M
CO4	M	H	-	-	M	L	-	-	-	H	L	-	M
CO5	M	H	H	L	M	-	-	-	L	M	-	L	L
CO6	M	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Rajasudhakar

Elective I : Database and Tools for Bioinformatics

Semester: V | **Course Code : I23BI5:B**
Credits: 3 | **Hours / Week: 4**

1. Course Outcomes

After completing the course, the students able to:

CO. No	Course Outcomes	Level	Unit
CO1	Discuss the genome sequences repositories and derived databases	K2	I
CO2	Explain the structural database and its classification	K2	II
CO3	Classify various visualization tools and its usage	K2	III
CO4	Use the docking software to design drug and predict active site	K3	IV
CO5	Describe how bioinformatics data is store and organized	K2	V
CO6	Categorize the applications Genomic database in various fields	K4	I

2. A. Syllabus

Unit I –Introduction to Genome Databases-I **15 Hours**

1.1. Database-Repositories for high throughput genomic sequences: EST, STS GSS ;

1.2. Genome Databases at NCBI, EBI, TIGR, SANGER – Viral Genomes.

Unit II - Introduction to Genome Databases-II **15 Hours**

2.1. Archeal and Bacterial Genomes Database;

2.2. Eukaryotic genomes with special reference to model organisms, Yeast, Drosophila, C. elegans, Rat, Mouse, Human, plants such as Arabidopsis thaliana, Rice.

Unit III–Specialized Databases **15 Hours**

3.1. Protein derived databases-InterPro, Prosite, Pfam, ProDom;

3.2. Structure: FSSP, DSSP.

3.3. Databases of structure-based classification; CATH and SCOP

Unit IV–Biomolecule Visualization Tools **15 Hours**

4.1. Introduction structural database,
4.2. Protein Visualization tools-Rasmol-SwissPDBviewer-Chime, Cn3D.
4.3. Tools used for homology modeling.

Unit V –Applications of Various Biomolecule Tools **15 Hours**

5.1. Principle and Application Drug designing;
5.2. Tools used for computational Drug Design
5.3. Target Selection; Active site prediction;
5.4. Small molecule building-Chemsketch, SMILES;
5.5. Docking using gemdock.

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Analysis of protein and nucleic acid sequences	https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod6.pdf
2	Functional Genomics	https://www.youtube.com/watch?v=u-98h4gDQoQ&feature=emb_logo
3	structure-based classification	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4498303/
4	Computational Drug Design	https://www.youtube.com/watch?v=hEUj-ZcxkcM

C. Text Book(s)

1. JinXiong, Essential Bioinformatics, Cambridge University Press,2006.
2. Bioinformatics: Databases and Algorithms, N. Gautham, Narosa Publishing House. 2005

D. Reference Book(s)

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
2. Higgins, D and Taylor.W (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi, 2000.
3. Durbin.R, Eddy. S.R, Krogh.A and Mitchison.G, Biological Sequence Analysis, Cambridge Univ. Press, Cambridge, UK, 1998.
4. Gibson.G&Muse.S. V, A Primer of Genome Science, Sinauer Associates, Inc. Publishers, 2002.
5. Baxevanis. A and Ouellette.B.F, Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ, 2005.

6. Campbell.A.M&Heyer.L.J, Discovering Genomics, Proteomics & Bioinformatics, CSHL Press, 2003.
7. Creighton.T.E, Protein Function A Practical Approach, Oxford university press, 2004.

E. Weblinks

1. https://www.youtube.com/watch?v=7jaFsREEz8c
2. https://www.youtube.com/watch?v=DdLbNouYrJc
3. https://www.youtube.com/watch?v=FioRil-0bZE

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to Genome Databases-I**		
1.1	Database-Repositories for high throughput genomic sequences: EST, STS GSS	Explain the high throughput genomic sequences: EST, STS GSS	K2
1.2	Genome Databases at NCBI, EBI, TIGR, SANGER – Viral Genomes.	Discuss the genome databases at NCBI, EBI, TIGR, SANGER	K2
2	**Introduction to Genome Databases-II**		
2.1	Archeal and Bacterial Genomes Database	Define the archeal and bacterial genomes database	K1
2.2	Eukaryotic genomes with special reference to model organisms, Yeast, Drosophila, C. elegans, Rat, Mouse, Human, plants such as Arabidopsis thaliana, Rice.	Discuss the eukaryotic genomes with special reference to model organisms	K2
3	**Specialized Databases**		
3.1	Protein derived databases-InterPro, Prosite, Pfam, ProDom	Define the protein derived databases	K1
3.2	Structure: FSSP, DSSP.	Explain the FSSP, DSSP	K2
3.3	Databases of structure-based classification; CATH and SCOP	Summarize the applications CATH and SCOP	K2
4	**Biomolecule Visualization Tools**		
4.1	Protein 3D Structure Introduction structural database	Explain the protein 3D structure database	K2
4.2	Protein Visualization tools-Rasmol-Swiss PDB viewer-Chime, Cn3D.	Demonstrate the steps involved in protein visualization tools	K3
4.3	Tools used for homology modeling	Evaluate the modeled protein structure	K5
5	**Applications of Various Biomolecule Tools**		
5.1	Principle and Application Drug designing	Explain the structural Bioinformatics-structure based drug design	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5.2	Tools used for computational Drug Design	Identify the new drug involved in structure bases drug design	K2
5.3	Target Selection; Active site prediction	Calculate the ADME properties of small molecules	K4
5.4	Small molecule building-Chemsketch, SMILES	Analyze the small molecule	K4
5.5	Docking using gemdock	Demonstrate the steps involved in docking software	K3

4. Mapping Scheme

I20BI5:2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	M	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	-	-	-	-	H	-	-	L
CO5	M	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Rajasudhakar

Elective II : Biostatistics and Numerical Methods

Semester : V **Course Code : I23BI5:C**

Credits : 3 **Hours / Week : 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Explain the basics concept of numerical measures	K2	I
CO2	Construct the correlation and regression coefficient for bivariate data	K3	II
CO3	Knows the application of Baye's theorem	K3	III
CO4	Quantify the different types of rule in numerical integration	K4	IV
CO5	Catalogue different methodologies for solving ordinary differential equations	K4	V
CO6	Apply the concepts of Euler's Methods in differential equations to execute biological algorithms	K3	V

2. A. Syllabus

Unit I - Numerical Measures **15 Hours**

1.1. Review of types and frequency distribution
1.2. Graphical representation of data
1.3. Measures of central tendency – mean, median, Mode
1.4. Measures of Dispersion- range, interquartile range,
1.5. Variance and Standard deviation, Coefficient of Variation and Applications. (Problems only, Derivations not included.)

Unit II - Correlation and Regression **15 Hours**

2.1. The two way scatter plot- Pearson's correlation coefficient- spearman's rank correlation coefficient.
2.2. Regression concepts-the population regression line- the method of least squares
2.3. Inference for regression coefficients – inference for predicted values. (Problems only, Derivations not included.)

Unit III - Probability **15 Hours**

3.1. Events and Probability

3.2. Conditional probability- Baye's Theorem.

3.3. Probability distribution- Binomial Distribution. (Problems only, Derivations not included.)

Unit IV - Numerical Integration **15 Hours**

4.1. Introduction – A general quadrature formula for equidistant ordinates (or Newton-cote's formula)

4.2. The Trapezoidal rule

4.3. Simpson's one third rule - Simpson's three eighths rule. (Problems only, Derivations not included.)

Unit V - Numerical Solutions for Ordinary Differential Equations **15 Hours**

5.1. Solution by Euler's Methods

5.2. Modified Euler's method- second order Runge-kutta method for first order ordinary differential equations

5.3. Fourth order Runge-kutta method for first order ordinary differential equations. (Problems only, Derivations not included.)

B. Topics for Self Study

S.No	Topics	Weblinks
1	Test of Hypothesis	https://nptel.ac.in/courses/103/106/103106120/
2	t - test	https://nptel.ac.in/content/storage2/courses/103106120/LectureNotes/Lec3_3.pdf
3	Analysis of covariance	https://nptel.ac.in/courses/111/104/111104075/
4	Multi step method	https://nptel.ac.in/courses/111/107/111107105/
5	Interpolation	https://nptel.ac.in/courses/111/107/111107062/

C. Text Book(s)

1. Pranab Kumar Banerjee, Introduction to Biostatistics, S.Chand& Company Ltd. 2006 Unit-I, Unit II - , Unit II - I only).

2. Kandasamy.P, Thikagavathy.K, Gunavathy.K, Numerical Methods, S.Chand&Comapany Ltd. 2003 (Unit-IV, Unit-V only).

D. Reference Book(s)

1. Veer BalaRastogi, Fundamentals of Biostatistics, Ane Books India. 2007

2. Sastry.S.S, Introductory Methods of Numerical Analysis, 2001.

E. Weblinks

1. https://www.youtube.com/watch?v=oyisOxM6aIY
2. https://www.youtube.com/watch?v=LzHUG0xv7Aw
3. https://www.youtube.com/watch?v=QqhSmdkqgjQ

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course contents	Learning Outcomes	HBTLT
1	**Numerical Measures**		
1.1	Review of types and frequency distribution	Exhibit data which shows the values of variables	K1
1.2	Graphical representation of data	Explain the data by various graphs	K2
1.3	Measures of central tendency	Calculate Mean, Median and Mode for grouped and ungrouped data	K3
1.4	Measures of Dispersion	Perform numerical solutions of mean deviation, quartile deviation and variance of discrete case and continuous case	K3
2	**Correlation and Regression**		
2.1	The two way scatter plot	Sketch the various types of scatter diagram	K3
2.2	Pearson's correlation coefficient ,	Perform the solution of correlation coefficient	K3
2.3	Spearman's rank correlation coefficient	Use the Spearman's method to find correlation coefficient	K3
2.4	Regression concepts , Inference for regression coefficients	Calculate the regression coefficient and interpret the same.	K4
25	The population regression line, Inference for predicted values	Sketch the line of regression by applying the method of least squares.	K3
3	**Probability**		
3.1	Events and Probability	Recall the basic concepts of probability of events	K1
3.2	Conditional probability	Solve the conditional probability of event	K3
3.3	Baye's Theorem.	Calculate theprobability of random experiment with new information	K4
3.4	Probability distribution, Binomial Distribution	Calculate the probability of distribution	K4

Unit/ Section	Course contents	Learning Outcomes	HBTLT
4	**Numerical Integration**		
4.1	A general quadrature formula	Report the general quadrature formula of polynomial	K2
4.2	Trapezoidal Rule,	Solve the numerical integration of integral for a given function from a given set of tabular values	K3
4.3	Simpson's One Third Rule	Construct the solution of numerical integration for given set of tabular values	K3
4.4	Simpson's three eighth Rule.	Sketch the solution of numerical integration from tabular values	K3
5	**Numerical Solutions for Ordinary Differential Equations**		
5.1	Euler Method	Solve differential equation by Euler method	K3
5.2	Euler'sModified Method	Construct the solution of ordinary differential equations by Euler's Modified Method	K3
5.3	Second order RungeKutta Method, Fourth order RungeKutta Method	Sketch the solution of ordinary differential equation by RungeKutta second and fourth order	K3

4. Mapping Scheme

I20BI5:3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	L	L	L	-	L	L	L	L	L	M	L
CO2	M	M	M	L	L	L	L	M	L	M	L	M	N
CO3	L	M	L	L	L	L	-	-	L	M	-	L	L
CO4	M	M	M	L	-	L	-	L	-	M	-	L	L
CO5	L	M	L	L	-	L	-	L	-	M	L	L	M
CO6	L	M	L	L	-	L	-	L	-	L	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Mariappan

Elective II : Research Methodology

Semester : V **Course Code : I23BI5:D**

Credits : 3 **Hours / Week : 4**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the research and its types.	K1	I
CO2	List the factors are used in research formulation	K1	II
CO3	Sketch the research plan - Exploration, Description, Diagnosis, Experimentation	K3	III
CO4	Extrapolate Structure and components of scientific reports	K4	IV
CO5	Illustrate the different steps in the preparation, Layout, structure and Language of typical reports	K2	IV
CO6	Critique the environmental impacts, Ethical issues, ethical committees, Commercialization	K4	V
CO7	Analyze the reproduction of published material, Plagiarism, Citation and acknowledgement, Reproducibility and accountability	K4	V

2. A. Syllabus

Unit I –Introduction **15 Hours**

1.1. Objectives and types of research,

1.2. Motivation and objectives – Research methods & Methodology.

1.3. Types of research – Descriptive & Analytical, Applied & Fundamental, Quantitative, Qualitative, Conceptual, Empirical.

Unit II - Research Formulation **15 Hours**

2.1. Defining and formulating the research problem,

2.2. Selecting the problem, Necessity of defining the problem

2.3. Importance of literature review in defining a problem,

2.4. Literature review, Primary and secondary sources,

2.5. Development of working hypothesis.

Unit III - Research design and methods **15 Hours**

3.1. Research design – Basic Principles- Need of research design,

3.2. Features of good design, Important concepts relating to research design, 3.3. Developing a research plan - Exploration, Description, Diagnosis, Experimentation.

3.4. Determining experimental and sample designs.

Unit IV - Reporting and thesis writing **15 Hours**

4.1. Structure and components of scientific reports,

4.2. Types of report , Technical reports and thesis

4.3. Significance, Different steps in the preparation, Layout, structure and Language of typical reports

4.4. Illustrations and tables, Bibliography, referencing and footnotes.

Unit V - Application of results and ethics **15 Hours**

5.1. Environmental impacts, Ethical issues, ethical committees, Commercialization,

5.2. Copy right, royalty, Intellectual property rights, and patent law,

5.3. Trade Related aspects of Intellectual Property Rights,

5.4. Reproduction of published material, Plagiarism, Citation and acknowledgement, Reproducibility and accountability.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Understanding Research Methods	https://www.coursera.org/learn/research-methods
2	Qualitative Research Methods	https://www.coursera.org/learn/qualitative-methods
3	Writing in the Sciences	https://www.coursera.org/learn/sciwrite
4	Data Analysis and Interpretation Specialization	https://www.coursera.org/specializations/data-analysis
5	Qualitative Research Methods Courses	https://www.coursera.org/courses?query=qualitative%20research%20methods

C. Text Book(s)

1. Kothari, C.R.,.Research Methodology: Methods and Techniques. New Age International, 1990.

D. Reference Book(s)

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology, RBSA Publishers, 2002.

2. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International, 1990.

3. Sinha, S.C. and Dhiman, A.K., Research Methodology, EssEss Publications, 2002.

E. Weblinks

1. https://www.youtube.com/watch?v=ze5bS-DNERk
2. https://www.youtube.com/watch?v=UABF1zrW-eE
3. https://www.youtube.com/watch?v=noXzC8XCFiE

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction**		
1.1	Objectives and types of research	Describe the research	K1
		List out the types of research	K1
1.2	Motivation and objectives – Research methods & Methodology	Classify the research methods	K2
1.3	Types of research – Descriptive & Analytical, Applied & Fundamental, Quantitative, Qualitative, Conceptual, Empirical.	Demonstrate the types of research	K3
		Differentiate the different methods of research	K4
2	**Research Formulation**		
2.1	Defining and formulating the research problem	Define the research problem	K1
2.2	Selecting the problem, Necessity of defining the problem	Identify the necessity in problem selection	K2
2.3	Importance of literature review in defining a problem	Estimate the importance of literature review	K3
2.4	Literature review, Primary and secondary sources	List out the sources for primary and secondary literature sources	K1
2.5	Development of working hypothesis	Discuss the working hypothesis development	K2
3	**Research design and methods**		
3.1	Research design – Basic Principles- Need of research design	Interpret the basic principles and need of research design	K2
3.2	Features of good design, Important concepts relating to research design	Categorize the features of research design	K4
3.3	Developing a research plan - Exploration, Description, Diagnosis, Experimentation	Design a research plan	K5
3.4	Determining experimental and sample designs	Prepare an experimental design	K5
4	**Reporting and thesis writing**		
4.1	Structure and components of scientific reports	Catalogue the components of scientific reports	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.2	Types of report, Technical reports and thesis	Classify the types of report	K2
4.3	Significance, Different steps in the preparation, Layout, structure and Language of typical reports	Analyze the steps involved report preparation	K4
4.4	Illustrations and tables, Bibliography, referencing and footnotes	Illustrate the report details	K3
5	**Application of results and ethics**		
5.1	Environmental impacts, Ethical issues, ethical committees, Commercialisation	Define the environmental impacts and ethical issues	K1
5.2	Copy right, royalty, Intellectual property rights, and patent law	Integrate the types involved in IPR	K3
5.3	Trade Related aspects of Intellectual Property Rights	Collect the information about trade related IPR	K5
5.4	Reproduction of published material, Plagiarism, Citation and acknowledgement, Reproducibility and accountability	Investigate about plagiarism, citation and acknowledgement	K6

4. Mapping Scheme

I20BI5:4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Jebastin

Core VII : Database Management System & SQL

Semester : VI **Course Code : I23BI607**
Credits : 4 **Hours/Week : 6**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Classify the use of various types of Database	K2	I & II
CO2	Create databases using DDL commands	K5	III
CO3	Use DML commands for manipulating databases and tables	K3	III
CO4	Apply PL/SQL programs to work with databases	K3	III
CO5	Use Non-procedural languages and MySQL	K3	IV
CO6	Distinguish the application areas for RDBMS and NoSQL databases	K4	V

2. A. Syllabus

Unit I - Introduction to DBMS **15 Hours**

1.1. Introduction – History of Database systems.
1.2. Database system applications
1.3. Database systems vs file systems
1.4. View of data: Data abstraction
1.5. Instances and schemas
1.6. Database users and administrators
1.7. Transaction management
1.8. Database systems structure – Advantages and Disadvantages

Unit II - Various Data Models **15 Hours**

2.1. Database models.
2.2. Basic concepts and structure of entity relationship data model
2.3. Relational data model
2.4. Object-oriented data model
2.5. Object- relational data model
2.6. Network data model
2.7. Hierarchical data model
2.8. Integrity and Security

2.9. Normalization
2.10. Constraints
2.11. Indexing and hashing

Unit III - SQL Queries **15 Hours**

3.1. SQL basics
3.2. SQL Languages: DDL, DML, TCL, DCL
3.3. Working with databases and tables- working with data- joins- sub queries
3.4. Operators
3.5. Transactions: introduction to PL/SQL- simple PL/SQL programs
3.6. Functions

Unit IV - MySQL database **15 Hours**

4.1. Non-procedural languages
4.2. MySQL data types
4.3. MySQL : DDL, DML
4.4. Joins in MySQL

Unit V – NoSQL databases - MongoDB **15 Hours**

5.1. NoSQL databases
5.2. Introduction To MongoDB:What Is MongoDB?-Why MongoDB?-Terms Used In RDBMS and MongoDB-Data Types in MongoDB-MongoDBQuery Language.
5.3. Map reduce fundamentals
5.4. Exploring the world of Hadoop analysis
5.5. Cloud Storage: Overview-Cloud Storage providers

B. Topics for Self Study

S.No	Topics	Web links
1	DynamoDB	https://aws.amazon.com/dynamodb
2	NoSQL databases in Cloud	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6896126/
3	Managing Big Data with MySQL	https://www.coursera.org/learn/analytics-mysql
4	SQL Basics for Data Science Specialization	https://www.coursera.org/specializations/learn-sql-basics-data-science

C. Text Book(s)

1. Abraham Silberchatz, Henry F. Korth, S. Sudharshan, Database System Concepts (5th Edition), McGraw Hill, 2002 (Unit I - , II).
2. Bipin C. Desai, An introduction to database systems, Galgotia publications pvt. Ltd., New Delhi, 2003 (Unit I - , II,III).
3. VikramVaswani, The Complete Reference MySQL, Tata McGraw-Hill, New Delhi, 2002 (Unit -IV).
4. Seema Acharya and SubhashiniChellappan, “Big Data and Analytics”, Wiley India Pvt. Ltd., 2016. (UNIT- V)
5. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing : A Practical Approach”, The McGraw Hill, 2010. . (UNIT- V)

D. Reference Book(s)

1. James Martin, Principles of Database management, Prentice Hall of India, 1976.
2. James Martin, Computer database organization, Prentice Hall of India, 1977.
3. Peter Rob Carlos Coronel, Database systems, design, implementation & management, Course technology, 2000.
4. Database systems – A practical approach to design, implementation and management, Thomas cannolly and Carolyn begg, Pearson Education, 2002.
5. Ronald R. Plew and Ryan K. Stephens,(2000),” Teach Yourself SQL ”,Second Edition, Sams Publishing.
6. AviSilberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, Sixth Edition

E. Weblinks

1. https://www.youtube.com/watch?v=OWX4RvijwLw
2. https://www.youtube.com/watch?v=w1XdPholzWY
3. https://www.youtube.com/watch?v=9-uqoJK6KPc

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Introduction to DBMS		
1.1	Introduction – History of Database systems.	List the types of Database systems	K1
1.2	Database system applications	Identify the places where databases are in need	K2
1.3	Database systems vs file systems	Classify file system and database system	K2
1.4	View of data: Data abstraction	Explain pros and cons of database system structure.	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.5	Instances and schemas	Review instances and schemas	K2
1.6	Database users and administrators	Describe the limits of database users in different Levels	K2
1.7	Transaction management	Explain the use of commit and rollback	K2
1.8	Database systems structure – Advantages and Disadvantages.	Summarize the advantages of database system	K2
2	**Various Data Models**		
2.1	Database models.	Identify various database models	K2
2.2	Basic concepts and structure of entity relationship data model	Illustrate ER Models	K2
2.3	Relational data model	Explain relational model	K2
2.4	Object-oriented data model	Recall object-oriented concepts	K2
2.5	Object- relational data model	Demonstrate object-relational model	K3
2.6	Network data model	Discuss on network data model	K2
2.7	Hierarchical data model.	Illustrate hierarchical data model	K2
2.8	Integrity and Security	Solve security issues in databases	K3
2.9	Normalization	Apply normalization concept in table data	K3
2.10	Constraints	Practice setting Primary key and Foreign key in tables	K3
2.11	Indexing and hashing.	Employ indexing for fast retrieval of data from databases	K3
3	**SQL Queries**		
3.1	SQL basics	Discuss about SQL	K2
3.2	SQL Languages: DDL, DML, TCL, DCL	Create databases and tables using commands	K5
3.3	Working with databases and tables- working with data- joins- sub queries	Construct tables by joining two or more tables	K5
3.4	Operators	Use operators in queries	K3
3.5	Transactions: introduction to PL/SQL- simple PL/SQL programs	Test PL/SQL programs for data manipulation	K4
3.6	Functions	Practice with functions	K3
4	**MySQL database**		
4.1	Non-procedural languages	Describe Non-procedural languages	K2
4.2	MySQL data types	Discuss about key-value pair databases	K2
4.3	MySQL : DDL, DML	Explain document databases	K2
4.4	Joins in MySQL		

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5	**NoSQL databases - MongoDB**		
5.1	NoSQL databases	Demonstrate the needs of databases and integration in Bioinformatics	K3
5.2	**Introduction To MongoDB:**	Experiment with MongoDB	K4
5.3	Map reduce fundamentals	Express Map reduce concept	K2
5.4	Exploring the world of Hadoop analysis	Experiment the logic of Hadoop database	K4
5.5	Cloud Storage: Overview-Cloud Storage providers	Describe Cloud storage	K2

4. Mapping Scheme

I20BI607	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	-	L	M	M	L	H	-	L
CO2	M	M	M	H	H	M	-	H	H	L	H	-	L
CO3	H	H	H	H	H	H	H	H	H	L	H	-	L
CO4	H	H	H	H	H	H	H	H	H	M	H	-	M
CO5	H	H	H	H	M	L	-	H	H	H	H	-	M
CO6	H	H	H	H	H	H	H	H	H	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core VIII : Molecular Modeling And Drug Design

Semester : VI **Course Code : I23BI608**

Credits : 4 **Hours / Week : 6**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the concept of molecular modeling	K1	I
CO2	Identify the force field involved inbonded and nonbonded interaction	K2	II
CO3	Dramatize the interaction of molecular modeling simulation	K3	III
CO4	Apply different algorithms for energy minimization	K3	III
CO5	Analyze molecular dynamics simulation methods for monitoring molecular interaction	K4	IV
CO6	Assess the various structure prediction methods used in drug designing	K6	V

2. A. Syllabus

Unit I - Introduction to Molecular Modeling **15 Hours**

1.1. Introduction - Useful Concepts in Molecular Modelling:
1.2. Coordinate Systems.
1.3. Potential Energy Surfaces.
1.4. Molecular Graphics.
1.5. Surfaces.
1.6. Computer Hardware and Software.
1.7. The Molecular Modelling Literature

Unit II - Force Fields **15 Hours**

2.1. Fields.
2.2. Bond Stretching.
2.3. Angle Bending.
2.4. Introduction to Non-bonded Interactions.
2.5. Electrostatic Interactions.
2.6. Van der Waals Interactions.
2.7. Hydrogen Bonding in Molecular Mechanics.
2.8. Force Field Models for the Simulation of Liquid Water.

Unit III - Energy Minimisation and Computer Simulation **15 Hours**

3.1. Minimisation and Related Methods for Exploring the Energy Surface.
3.2. Non-Derivative method,
3.3. 1st order minimization methods
3.4. 2nd order minimisation methods.
3.5. Computer Simulation Methods.
3.6. Simple Thermodynamic Properties
3.7. Phase Space.
3.8. Boundaries.

Unit IV - Molecular Dynamics & Monte Carlo Simulation **15 Hours**

4.1. Molecular Dynamics Simulation Methods.
4.2. Molecular Dynamics Using Simple Models.
4.3. Molecular Dynamics with Continuous Potentials.
4.4. Molecular Dynamics at Constant Temperature and Pressure.
4.5. Molecular Modeling software: BIOSUITE

Unit V -Structure Prediction and Drug Design **15 Hours**

5.1. Structure Prediction
5.2. Introduction to Comparative Modeling.
5.3. Sequence Alignment.
5.4. Constructing and Evaluating a Comparative Model.
5.5. Predicting Protein Structures by 'Threading',
5.6. Molecular Docking, AUTODOCK and HEXPERIMENTS
5.7. Structure based De Novo Ligand design,
5.8. Drug Discovery
5.9. Cheminformatics
5.10. QSAR.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Concepts and importance of Bioinformatics	https://www.youtube.com/watch?v=sREv4rfpbCY&feature=emb_logo
2	Protein Structure and Function	https://www.youtube.com/watch?v=lO6NvkC0GjU&feature=emb_logo
3	E.M. in molecular docking	https://www.youtube.com/watch?v=7VK-08rMNfY&feature=emb_logo
4	Mutations stability	https://www.youtube.com/watch?v=p3N6oVlNh-Q&feature=emb_logo
5	Macromolecule Interactions	https://www.youtube.com/watch?v=1XqVIRo9SQA&feature=emb_logo

C. Text Book(s)

1. Leach, AR (2001) "Molecular Modeling – Principles and Applications"; Second Edition, Prentice Hall, USA.
2. Alan Hinchliffe, Modeling Molecular Structures, 2nd Edition, John,Wiley, 2000.
3. Alan Hinchliffe, Molecular Modeling for Beginners, John,Wiley, 2003.
4. Schlick T, "Molecular Modeling and Simulation An Interdisciplinary Guide", Springer, Acc. No. 73052.

D. Reference Book(s)

1. Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery, Rastogi,S.C. Parag Rastogi, N. Mendiratta, 4th Edition.2008.
2. Bioinformatics: Principles and Applications, Zhumur Ghosh, BibekanandMallick, Oxford Press. 2015.
3. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego,1996.
4. Frenkel D and Smith B, Understanding Molecular Simulations. From Algorithms to Applications, Academic Press, samdiego, California, 1996.
5. Kalos and P.A Whitlock, Monte Carlo Methods, John Wiley & Sons, New York, 1986.
6. McCammon JA and Harvey SC. Dynamics of Proteins and Nucleic Acids. Cambridge University Press, Cambridge, 1987.
7. Vogel H ,"Drug Discovery and Evaluation: Pharmacological Assays", Springer, 2007,

E. Weblinks

1. https://www.youtube.com/watch?v=QIWFBGeF-FE
2. https://www.youtube.com/watch?v=wNT9_Iu5Cbk
3. https://www.youtube.com/watch?v=Vpoa3XIahnQ&t=1107s

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Introduction to Molecular Modeling**		
1.1.	Introduction - Useful Concepts in Molecular Modelling:	Record the basic concepts of molecular modeling	K1
1.2	Coordinate Systems.	Use the knowledge of coordinate systems to specify the atom position	K3
1.3	Potential Energy Surfaces.	Explain the significance of potential energy in molecular geometry	K2

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1.4	Molecular Graphics.	Using the computational visualization tools to view various structures.	K3
1.5	Surfaces.		K3
1.6	Computer Hardware and Software.	Explain the various hardware and software components involved in molecular modeling	K2
1.7	The Molecular Modelling Literature	Discuss in detail the molecular modeling concepts	K2
2	**Force Fields**		
2.1	Fields	Define force field	K2
2.2	Bond Stretching	Use of force field in Bond stretching and angle bending	K3
2.3	Angle Bending		
2.4	Introduction to Non-bonded Interactions.	Explain Non-bonded interactions	K2
2.5.	Electrostatic Interactions	Define coulombs law in electrostatic interaction Apply mathematical formula to calculate the electrostatic interactions	K2 K3
2.6	Van der Waals Interactions	Apply Lennard-Jones potential in vanderwalls interaction calculation	K3
2.7	Hydrogen Bonding in Molecular Mechanics	Explain the types of interactions which reinforce or weaken a H-bond	K2
2.8	Force Field Models for the Simulation of Liquid Water	Examine the behaviour of macromolecules using forcefield	K3
3	**Energy Minimisation and Computer Simulation**		
3.1	Minimisation and Related Methods for Exploring the Energy Surface	Classify the different energy minimization methods	K2
3.2	Non-Derivative method	Application of non derivative methods in molecular dynamics	K3
3.3	1st order minimization methods	Explain the difference between 1st and 2nd order minimization methods	K2
3.4	2nd order minimisation methods		
3.5	Computer Simulation Methods	Describe the different computer simulation methods	K2
3.6	Simple Thermodynamic Properties		K2
3.7	a. Phase Space	Apply the principles of thermodynamics in determining the phase space and boundaries	K3
3.8	b. Boundaries		
4	**Molecular Dynamics & Monte Carlo Simulation**		
4.1	Molecular Dynamics Simulation Methods	State the principles of molecular dynamics simulation	K2

Unit/ Section	Course Content	Learning Outcomes	HBTLT
4.2	Molecular Dynamics Using Simple Models	Categorize the algorithms and computational methods of molecular dynamics simulation	K4
4.3	Molecular Dynamics with Continuous Potentials	Analyzing the trajectories and results of a simulation	K4
4.4	Molecular Dynamics at Constant Temperature and Pressure	Illustrate the structural and dynamic property of the molecule in different temperature and pressure	K2
4.5	Molecular Modeling software: BIOSUITE	Explain the molecular modeling software	K2
5	**Structure Prediction and Drug Design**		
5.1	Structure Prediction	Distinguish between good, medium and poor quality structures	K4
5.2	Introduction to Comparative Modeling	Using the appropriate tool for predicting the protein structure	K3
5.3	Sequence Alignment	Interpret the metrics used to assess the quality of a pairwise sequence alignment, identity versus similarity	K5
5.4	Constructing and Evaluating a Comparative Model	Create a theoretical modelof a protein after aligning the template with the query sequence	K5
5.5	Predicting Protein Structures by 'Threading',	Propose a theoretical model for an unknown protein sequence which lacks the template	K5
5.6	Molecular Docking, AUTODOCK and HEX	Evaluate the efficiency of softwares AUTODOCK and HEX in molecular docking	K6
5.7	Structure based De Novo Ligand design	Design an appropriate ligand to fit into the target receptor	K5
5.8	Drug Discovery	Report on the drug discovery process	K6
5.9	Chemoinformatics	Relate the role of chemistry in bioinformatics	K4
5.10	QSAR	Conclude the relationship between the structure and activity of ligands with the help of QSAR	K6

4. **Mapping Scheme**

I20BI608	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	L	M	-	-	-	L	L	M	H	M	M
CO2	M	M	-	L	L	-	-	L	-	H	H	M	M
CO3	H	H	M	M	L	L	L	L	-	M	H	M	M
CO4	M	M	M	M	L	L	-	L	-	M	H	M	M
CO5	M	M	M	M	L	L	-	L	-	M	H	M	M
CO6	H	H	M	L	L	L	L	L	L	H	H	M	M

L: Low **M: Medium** **H: High**

5. **Course Assessment Methods**

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Jebastin

Core Prac VII : Database Management System & SQL LAB

Semester : VI **Course Code : I23BI6P7**

Credits : 2 **Hours/Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Create databases and tables	K5	1,2
CO2	Apply relational and mathematical operators	K3	3,4,5
CO3	Use different data types based on requirements	K3	6,7
CO4	Experiment joining tables	K4	8,9
CO5	Practicevarious operations on fields	K3	10
CO6	Test the usage of backend when developing applications	K4	11,12

2. A. List of Experiments

1. Create a table named "Orders" with the following fields.

ord_no	Int
purch_amt	number
ord_date	date
customer_id	int
salesman_id	int

a) Describe the "Orders" Table

b) Alter the "Orders" table by including a field 'Comments' of String datatype.

c) Describe table

d) Insert the given records into "Orders" table (Use Insert/Insert All)

Ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.5	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.5	2012-08-17	3009	5003

Ord_no	purch_amt	ord_date	customer_id	salesman_id
70007	948.5	2012-09-10	3005	5002
70005	2400.6	2012-07-27	3007	5001
70008	5760	2012-09-10	3002	5001
70010	1983.43	2012-09-10	3004	5006
70003	2480.4	2012-09-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.6	2012-04-25	3002	5001

e) Write a SQL statement to find the total purchase amount of all orders.

f) Write a SQL statement to find the number of salesmen currently listing for all of their customers

g) Write a SQL statement to find the highest purchase amount on a date '2012-08-17' for each salesman with their ID.

h) Write a SQL statement to find the highest purchase amount with their ID and order date, for those customers who have a higher purchase amount ina day is within the range 2000 and 6000

i) Write a SQL statement that counts all orders for a date August 17th, 2012

2. Create a table named "Orders" with the following fields.

ord_no	Int
purch_amt	Number
ord_date	String
customer_id	Int
salesman_id	Int

a) Describe the "Orders" Table

b) Alter the "Orders" table by changing the datatype of 'ord_date' from String to Date.

c) Describe table

d) Insert the given records into "Orders" table (Use Insert/Insert All)

ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.5	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.5	2012-08-17	3009	5003

ord_no	purch_amt	ord_date	customer_id	salesman_id
70007	948.5	2012-09-10	3005	5002
70005	2400.6	2012-07-27	3007	5001
70008	5760	2012-09-10	3002	5001
70010	1983.43	2012-09-10	3004	5006
70003	2480.4	2012-09-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.6	2012-04-25	3002	5001

e) Write a SQL statement to find the average purchase amount of all orders

f) Write a SQL statement to find the highest purchase amount ordered by the each customer on a particular date with their ID, order date and highest purchase amount.

g) Write a SQL statement to find the highest purchase amount with their ID and order date, for only those customers who have a higher purchase amount in a day is within the list 2000, 3000, 5760 and 6000

h) Write a SQL statement to find the highest purchase amount ordered by the each customer with their ID and highest purchase amount.

i) Write a query that counts the number of salesmen with their order date and ID registering orders for each day.

3. Create a table named "Orders" with the following fields.

ord_no	Int
purch_amt	Number
ord_date	Date
customer_id	Int
salesman_id	Int
comments	String

a) Describe the "Orders" Table

b) Alter the "Orders" table by removing the field 'Comments'.

c) Describe table

d) Insert the given records into "Orders" table (Use Insert/Insert All)

ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.5	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001

ord_no	purch_amt	ord_date	customer_id	salesman_id
70004	110.5	2012-08-17	3009	5003
70007	948.5	2012-09-10	3005	5002
70005	2400.6	2012-07-27	3007	5001
70008	5760	2012-09-10	3002	5001
70010	1983.43	2012-09-10	3004	5006
70003	2480.4	2012-09-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.6	2012-04-25	3002	5001

e) Write a SQL statement to get the maximum purchase amount of all the orders

f) Write a SQL statement to find the highest purchase amount with their ID and order date, for only those customers who have highest purchase amount in a day is more than 2000

g) Write a SQL statement to find the highest purchase amount with their ID, for only those customers whose ID is within the range 3002 and 3007

h) Write a SQL statement to display customer details (ID and purchase amount) whose IDs are within the range 3002 and 3007 and highest purchase amount is more than 1000

i) Write a SQL statement to find the highest purchase amount with their ID, for only those salesmen whose ID is within the range 5003 and 5008

4. Create a table named "Customer" with the following fields.

customer_id	Int
cust_name	String
city	String
Grade	salesman_id

a) Describe "Customer" table

b) Insert the given records into "Customer" table (Use Insert/Insert All)

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3007	Brad Davis	New York	200	5001
3005	Graham Zusi	California	200	5002
3008	Julian Green	London	300	5002
3004	Fabian Johnson	Paris	300	5006

customer_id	cust_name	city	grade	salesman_id
3009	Geoff Cameron	Berlin	100	5003
3003	Jozy Altidor	Moscow	200	5007
3001	Brad Guzan	London		5005

c) Write a SQL statement to know how many customer have listed their names.

d) Write a SQL statement find the number of customers who gets at least a gradation for his/her performance

e) Write a SQL statement which selects the highest grade for each of the cities of the customers

f) Create a table named "Salesman" with the following fields

salesman_id	number
name	string
City	string
Commission	number

g) Insert the given records into "Salesman" table (Use Insert/Insert All)

salesman_id	name	City	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5007	Paul Adam	Rome	0.13
5003	Lauson Hen	San Jose	0.12

h) Write a SQL statement that count the number of salesmen for whom a city is specified. Note that there may be spaces or no spaces in the city column if no city is specified.

5. Create a table named "Item_mast" with the following fields.

Pro_Id	int
Pro_Name	string
Pro_Price	number
Pro_Com	number

a) Describe “Item_mast” table

b) Insert the given records into “Item_mast” table (Use Insert/Insert All)

Pro_Id	Pro_Name	Pro_Price	Pro_Com
101	Mother Board	3200	15
102	Keyboard	450	16
103	ZIP drive	250	14
104	Speaker	550	16
105	Monitor	5000	11
106	DVD drive	900	12
107	CD drive	800	12
108	Printer	2600	13
109	RefillCatridge	350	13
110	Mouse	250	12

c) Write a SQL query to calculate the average price of all the products.

d) Write a SQL query to find the number of products with a price more than or equal to Rs.350

e) Write a SQL query to display the average price of each company's products, along with their code.

f) Create a table named “emp_department” with the following fields

Emp_Id	Number
Emp_Fname	string
Emp_Lname	String
Emp_Dept	Number

g) Insert the given records into “emp_department” table (Use Insert/ Insert All)

Emp_Id	Emp_Fname	Emp_Lname	Emp_Dept
127323	Michale	Robbin	57
526689	Carlos	Snares	63
843795	Enric	Dosio	57
328717	Jhon	Snares	63
444527	Joseph	Dosni	47
659831	Zanifer	Emily	47
847674	Kuleswar	Sitaraman	57
748681	Henrey	Gabriel	47
555935	Alex	Manuel	57

Emp_Id	Emp_Fname	Emp_Lname	Emp_Dept
539569	George	Mardy	27
733843	Mario	Saule	63
631548	Alan	Snappy	27
839139	Maria	Foster	57

h) Write a query in SQL to find the number of employees in each department along with the department code

i) Select all the employees whose Department id is 57.

6. Create a table named "Movies" with the following fields.

i

Id	Int
Title	string
Director	String
Year	String
Length mins	Int

a) Describe the table "Movies"

b) Alter the Table "Movies" by changing the datatype of 'Year' field from string to number.

c) Insert the given records into "Item_mast" table (Use Insert/Insert All)

Id	Title	Director	Year	Lengthminutes
1	Toy Story	John Lasseter	1995	81
2	A Bug's Life	John Lasseter	1998	95
3	Toy Story 2	John Lasseter	1999	93
4	Monsters, Inc.	Pete Docter	2001	92
5	Finding Nemo	Andrew Stanton	2003	107
6	The Incredibles	Brad Bird	2004	116
7	Cars	John Lasseter	2006	117
8	Ratatouille	Brad Bird	2007	115
9	WALL-E	Andrew Stanton	2008	104
10	Up	Pete Docter	2009	101
11	Toy Story 3	Lee Unkrich	2010	103
12	Cars 2	John Lasseter	2011	120
13	Brave	Brenda Chapman	2012	102
14	Monsters University	Dan Scanlon	2013	110

d) Create a table named "Boxoffice" with the following fields.

Movie_id	int
Rating	int
Domestic_sales	int
International_sales	int

e) Insert the given records into "Boxoffice" table (Use Insert/Insert All)

Movie_id	Rating	Domestic_sales	International_sales
5	8.2	380843261	555900000
14	7.4	268492764	475066843
8	8	206445654	417277164
12	6.4	191452396	368400000
3	7.9	245852179	239163000
6	8	261441092	370001000
9	8.5	223808164	297503696
11	8.4	415004880	648167031
1	8.3	191796233	170162503
7	7.2	244082982	217900167
10	8.3	293004164	438338580
4	8.1	289916256	272900000
2	7.2	162798565	200600000
13	7.2	237283207	301700000

f) Find the domestic and international sales for each movie

g) Show the sales numbers for each movie that did better internationally rather than domestically

h) List all the movies by their ratings in descending order

7. Create a table named "Buildings" with the following fields.

Building_name	string
Capacity	int

a) Describe table “Buildings”

b) Insert the given records into “Buildings” table (Use Insert/Insert All)

Building_name	Capacity
1e	24
1w	32
2e	16
2w	20

a) Create a table named “Employees” with the following fields.

Role	string
Name	string
Building	string
Years_employed	int

b) Insert the given records into “Employees” table (Use Insert/Insert All)

Role	Name	Building	Years_employed
Engineer	Becky A.	Le	4
Engineer	Dan B.	Le	2
Engineer	Sharon F.	1e	6
Engineer	Dan M.	1e	4
Engineer	Malcom S.	Le	1
Artist	Tylar S.	2w	2
Artist	Sherman D.	2w	8
Artist	Jakob J.	2w	6
Artist	Lillia A.	2w	7
Artist	Brandon J.	2w	7
Manager	Scott K.	1e	9
Manage	Shirlee M.	1e	3
Manager	Daria O.	2w	6

c) Find the list of all buildings that have employees

d) Find the list of all buildings and their capacity

e) List all buildings and the distinct employee roles in each building (including empty buildings)

8. Create a table named "Customer" with the following fields.

customer_id	Int
cust_name	String
city	String
grade	Int
salesman_id	Int

a) Insert the given records into "Customer" table (Use Insert/Insert All)

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3007	Brad Davis	New York	200	5001
3005	Graham Zusi	California	200	5002
3008	Julian Green	London	300	5002
3004	Fabian Johnson	Paris	300	5006
3009	Geoff Cameron	Berlin	100	5003
3003	Jozy Altidor	Moscow	200	5007
3001	Brad Guzan	London		5005

b) Write a query to display all customers with a grade above 100

c) Write a query statement to display all customers in New York who have a grade value above 100

d) Write a SQL statement to display all customers, who are either belongs to the city New York or had a grade above 100

e) Write a SQL statement to display all the customers, who are either belongs to the city New York or not had a grade above 100

f) Write a SQL query to display those customers who are neither belongs to the city New York nor grade value is more than 100.

9. Create a table named "Orders" with the following fields.

ord_no	int
purch_amt	number
ord_date	date
customer_id	int
salesman_id	int

a) Describe the "Orders" Table

b) Alter the "Orders" table by including a field 'Comments' of String datatype.

c) Describe table

d) Insert the given records into “Orders” table (Use Insert/Insert All)

ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.5	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.5	2012-08-17	3009	5003
70007	948.5	2012-09-10	3005	5002
70005	2400.6	2012-07-27	3007	5001
70008	5760	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.4	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.6	2012-04-25	3002	5001

e) Write a SQL statement to display either those orders which are not issued on date 2012-09-10 and issued by the salesman whose ID is 505 and below or those orders which purchase amount is 1000.00 and below

f) Write a SQL query to display all orders where purchase amount less than 200 or exclude those orders which order date is on or greater than 10th Feb,2012 and customer id is below 3009

g) Write a SQL statement to exclude the rows which satisfy 1) order dates are 2012-08-17 and purchase amount is below 1000 2) customer id is greater than 3005 and purchase amount is below 1000.

h) Write a SQL query to display order number, purchase amount, achieved, the unachieved percentage for those order which exceeds the 50% of the target value of 6000

10. Create a table named “Salesman” with the following fields. (Subquery)

salesman_id	Int
Name	String
city	String
commission	Float

a) Insert the given records into “Salesman” table (Use Insert/Insert All)

salesman_id	Name	city	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hen	San Jose	0.12
5007	Paul Adam	Rome	0.13

b) Create a table named “Orders” with the following fields.

ord_no	Int
purch_amt	Number
ord_date	date
customer_id	Int
salesman_id	Int

c) Insert the given records into “Orders” table (Use Insert/Insert All)

ord_no	purch_amt	ord_date	customer_id	salesman_id
70001	150.5	2012-10-05	3005	5002
70009	270.65	2012-09-10	3001	5005
70002	65.26	2012-10-05	3002	5001
70004	110.5	2012-08-17	3009	5003
70007	948.5	2012-09-10	3005	5002
70005	2400.6	2012-07-27	3007	5001
70008	5760	2012-09-10	3002	5001
70010	1983.43	2012-10-10	3004	5006
70003	2480.4	2012-10-10	3009	5003
70012	250.45	2012-06-27	3008	5002
70011	75.29	2012-08-17	3003	5007
70013	3045.6	2012-04-25	3002	5001

d) Write a query to display all the orders from the orders table issued by the salesman 'Paul Adam'.

e) Write a query to display all the orders for the salesman who belongs to the city London.

f) Write a query to find all the orders issued against the salesman who may works for customer whose id is 3007.

g) Write a query to display all the orders which values are greater than the average order value for 10th October 2012.

h) Write a query to find all orders attributed to a salesman in New york.

11. Create a table named "Salesman" with the following fields (Subquery)

salesman_id	Int
Name	String
city	String
Commission	Float

a) Insert the given records into"Salesman" table(Use Insert/Insert All)

salesman_id	**name**	**city**	**commission**
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hen	San Jose	0.12
5007	Paul Adam	Rome	0.13

b) Create a table named "Customer" with the following fields

customer_id	Int
cust_name	String
City	String
Grade	Int
salesman_id	Int

c) Insert the given records into "Customer" table (Use Insert/Insert All)

customer_id	**cust_name**	**city**	**grade**	**salesman_id**
3002	Nick Rimando	New York	100	5001
3007	Brad Davis	New York	200	5001
3005	Graham Zusi	California	200	5002
3008	Julian Green	London	300	5002

customer_id	cust_name	city	grade	salesman_id
3004	Fabian Johnson	Paris	300	5006
3009	Geoff Cameron	Berlin	100	5003
3003	Jozy Altidor	Moscow	200	5007
3001	Brad Guzan	London		5005

d) Write a query to display the commission of all the salesmen servicing customers in Paris.

e) Write a query to display all the customers whose id is 2001 bellow the salesman ID of Mc Lyon.

f) Write a query to count the customers with grades above New York's average.

g) Write a query to find salesmen with all information who lives in the city where any of the customers lives

h) Write a query to find all those customers whose grade are not as the grade, belongs to the city Paris.

12. Create a table named "Salesman" with the following fields (Union)

salesman_id	Int
Name	String
city	String
Commission	Float

a) Insert the given records into "Salesman" table (Use Insert/Insert All)

salesman_id	name	city	commission
5001	James Hoog	New York	0.15
5002	Nail Knite	Paris	0.13
5005	Pit Alex	London	0.11
5006	Mc Lyon	Paris	0.14
5003	Lauson Hen	San Jose	0.12
5007	Paul Adam	Rome	0.13

b) Create a table named "Customer" with the following fields.

customer_id	Int
cust_name	string
city	string
grade	Int
salesman_id	Int

c) Insert the given records into "Customer" table (Use Insert/Insert All)

customer_id	cust_name	city	grade	salesman_id
3002	Nick Rimando	New York	100	5001
3007	Brad Davis	New York	200	5001
3005	Graham Zusi	California	200	5002
3008	Julian Green	London	300	5002
3004	Fabian Johnson	Paris	300	5006
3009	Geoff Cameron	Berlin	100	5003
3003	Jozy Altidor	Moscow	200	5007
3001	Brad Guzan	London		5005

d) Write a query to display all salesmen and customer located in London.

e) Write a query to display distinct salesman and their cities.

f) Create a union of two queries that shows the names, cities, and ratings of all customers. Those with a rating of 200 or greater will also have the words "High Rating", while the others will have the words "Low Rating".

g) Write a SQL statement find the number of customers who gets at least a gradation for his/her performance.

h) Write a SQL statement to find the highest purchase amount ordered by the each customer with their ID and highest purchase amount.

MySql Exercise

13. Write a MySql statement to create Employee table with the following fields

Employee_id	Varchar(2)
First_name	Varchar(20)
Last_name	Varchar(20)
Salary	Decimal(10,2)
Joining_date	Date
Departement	Varchar(20)

a. Alter the Employee_id's data type as integer

b. Insert the given records into the table

Employee_id	First_name	Last_name	Salary	Joining_date	Departement
1	Bob	Kinto	1000000	2019-01-20	Finance
2	Jerry	Kansxo	6000000	2019-01-15	IT
3	Philip	Jose	8900000	2019-02-05	Banking
4	John	Abraham	2000000	2019-02-25	Insurance
5	Michael	Mathew	2200000	2019-02-28	Finance
6	Alex	chreketo	4000000	2019-05-10	IT
7	Yohan	Soso	1230000	2019-06-20	Banking

c. Update the First_name of Bob into Bobby

d. Delete the seventh Employee record

e. Get all employees

f. Display all the values of the "First_Name" column using the alias "Employee Name"

g. Get all "Last_Name" in uppercase.

h. Create a table named "Rewards" and insert the below records

Employee_ref_id	date_reward	amount
1	2019-05-11	1000
2	2019-02-15	5000
3	2019-04-22	2000
1	2019-06-20	8000

i. Trunkate the "Rewards" table

MongoDB

Exercise

14. {

```
  "address": {
     "building": "1007",
     "coord": [ -73.856077, 40.848447 ],
     "street": "Morris Park Ave",
     "zipcode": "10462"
  },
  "borough": "Bronx",
  "cuisine": "Bakery",
  "grades": [
     { "date": { "$date": 1393804800000 }, "grade": "A", "score": 2 },
     { "date": { "$date": 1378857600000 }, "grade": "A", "score": 6 },
     { "date": { "$date": 1358985600000 }, "grade": "A", "score": 10 },
```

```
    { "date": { "$date": 1322006400000 }, "grade": "A", "score": 9 },
    { "date": { "$date": 1299715200000 }, "grade": "B", "score": 14 }
  ],
  "name": "Morris Park Bake Shop",
  "restaurant_id": "30075445"
}
```

a. Write a MongoDB query to create a database named "Tourism" (Practice drop of a database)

b. Write a MongoDB query to create a collection "restaurants"

c. Write a MongoDB query to insert the above records in the collection "restaurants"

d. Write a MongoDB query to display all the documents in the collection restaurants

e. Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine for all the documents in the collection restaurant

f. Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine, but exclude the field _id for all the documents in the collection restaurant

g. Write a MongoDB query to find the restaurants that achieved a score, more than 80 but less than 100

h. Write a MongoDB query to display all the restaurant which is in the borough Bronx

i. Write a MongoDB query to display the first 5 restaurant which is in the borough Bronx

j. Write a MongoDB query to delete the restaurants who achieved a score more than 90

B. Topics for Self Study

S.No	Topics	Web links
1	Firebase	https://firebase.google.com/docs/storage/web/start
2	Normalization in databases	https://www.youtube.com/watch?v=px7HV91fx2I
3	Microsoft Azure Cloud databases	https://azure.microsoft.com/en-us/product-categories/databases/
4	Single cell Genomic insights using AWS	https://aws.amazon.com/solutions/case-studies/mission-bio/

C. Reference Book(s)

1. Database systems – A practical approach to design, implementation and management, Thomas cannolly and Carolyn begg, Pearson Education, 2002.
2. Ronald R. Plew and Ryan K. Stephens,(2000),” Teach Yourself SQL ”,Second Edition, Sams Publishing.

3. AviSilberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, Sixth Edition

D. Weblinks

1. https://www.youtube.com/watch?v=HXV3zeQKqGY
2. https://www.w3resource.com/recaptcha2.php?page=https://www.w3resource.com/mysql-exercises/
3. https://practity.com/sql/
4. https://www.techonthenet.com/sql/select_exercises.php
5. https://sqlbolt.com/

3. Specific Learning Outcomes (SLO)

Ex. No.	Course Contents	Learning Outcomes	HBTLT
1	Create a table using DDL Commands	Create tables in database	K5
2	Manipulate the table using DML Commands	Experiment manipulation of data in tables	K4
3	Create fields in table with different data types	Practice field names with different data types	K3
4	Write queries to use Arithmetic and Logical operators	Perform various operations in table data	K3
5	Write queries to use Aggregate functions	Use aggregate functions in data	K3
6	Write query to Join two or more tables	Build tables by joining more tables	K5
7	Write query to use Group functions for grouping fields	Demonstrate group functions	K3
8	Write query to Sort fields	Improve the table organization by sorting	K6

4. Mapping Scheme

I20BI6P7	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	-	L	H	H	M	L	M	H	H	L	H	-	H
CO2	M	M	M	M	-	-	-	M	H	L	H	-	H
CO3	M	H	H	M	H	L	H	H	H	M	H	-	H
CO4	H	H	H	H	M	-	H	H	H	H	H	-	H
CO5	L	L	L	L	H	M	L	H	H	M	M	L	H
CO6	H	H	M	M	L	L	L	H	H	H	H	L	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core Prac VIII : Advanced Bioinformatics Lab-II

Semester : VI **Course Code : I23BI6P8**

Credits : 2 **Hours / Week : 3**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiments Covered
CO1	Create the small molecules and prepare them in proper file format	K5	1
CO2	Interpret the post-docking results and analyze their interactions	K2	6
CO3	Analyze the biological properties of small molecules	K4	2
CO4	Perform the simple docking process for the given compounds	K3	5
CO5	Demonstrate the optimization steps for small molecules	K3	3
CO6	Critique the binding site information of the given protein	K4	4

2. A. List of Experiments

1. Creation and identification of small molecules through

(i) Searching Pubchem/Drugbank database

(ii) Build a small molecule using Marvin sketch

(iii) Convert a small molecule from one file format to another using OpenBabel.

2. Property calculation and similarity search of small molecules

(i) Drug Likeliness - MedChem Designer, Molinspiration

(ii) ADMET property prediction- PASS online server/Swiss ADME

(iii) Structure similarity search-ChEMBL

3. Energy minimisation& geometry optimization –Arguslab/ SPDBv/ AVOGADRO

4. Creation and identification of macromolecules

(i) Searching PDB database

(ii) Binding site analysis – Docsite scorer, 3DLigandSite

5. Docking using iGEMDOCK and Auto dock vina-PyRx.

6. Post Docking Analysis-Pose View

B. Topics for Self Study

S.No	Topics	Web links
1	Bioinformtics methods-2	https://www.coursera.org/learn/bioinformatics-methods-2
2	Glide docking	https://www.youtube.com/watch?v=htoaov6bQlk
3	Discovery studio	https://www.youtube.com/watch?v=tQUwqYT9434

C. Reference Book(s)

1. Jin Xiong, Essential Bioinformatics, Low Price Edition, Cambridge Press, 2019.
2. Mount D. Bioinformatics : Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York.2004.

D. Weblinks

1. https://www.youtube.com/watch?v=hEUj-ZcxkcM
2. https://www.youtube.com/watch?v=t9_nDt4ATwE

3. Specific Learning Outcomes (SLO)

Ex. No	Course contents	Learning Outcome	HBTLT
1	Creation and identification of small molecules through i. Searching pubchem / Drug Bank Database	Explain the comprehensive chemical information in discovery	K2
	ii. Build a small molecule using Marvin sketch	Predict the three dimensional structure of small molecule	K3
	iii. Convert a small molecule from one file format to another using OpenBabel.	Modify the chemical file format	K6
2	Property calculation and similarity search of small molecules i. Drug likeliness- Medchem Designer	Analyze the drug likeliness of the molecule	K4
	ii.ADMET property prediction- PASS online server/Swiss ADME	Predict the ADMET property of the molecule and its importance in drug discovery Justify the importance of ADMET property in drug discovery	K5
	iii. Structure similarity search-chEMBL	Design a compound library using similarity search	K6
3	Energy minimisation& geometry optimization –Arguslab/ SPDBV/ AVOGADRO	Assess the energy value of the molecule Interpret the structural stability of the molecule based on energy value	K5

Ex. No	Course contents	Learning Outcome	HBTLT
4	Creation and identification of macromolecules i. Searching PDB databases	How to retrieve the protein structure	K1
	ii. Binding site analysis	Predict the number of binding site present in a molecule Analyse the number of interaction between ligand and macromolecule	K6
5	Docking using iGEMDOCK and Auto dock vina-PyRx.	Apply in compound screening based on binding affinity of the molecule	K3
6	Post Docking analysis- Pose View	Evaluate 2D pose depictions and structure visualization	K5

4. Mapping Scheme

I20BI	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

Elective III : Biodiversity Informatics

Semester : VI | **Course Code : I23BI6:A**

Credits : 3 | **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Explain the basic concept of biodiversity	K2	I
CO2	Describe the importance of biodiversity	K2	II
CO3	Analyze the consequences of the loss of biodiversity	K4	III
CO4	Debatethe need for biodiversity conservation	K4	IV
CO5	Use of bioinformatics database in monitoring endangered species	K3	V
CO6	State the role of IPR in global biodiversity	K1	V

2. A. Syllabus

Unit I - Biodiversity Science **18 Hours**

1.1 Introduction to Biodiversity-Biodiversity –concept and definition-Scope of Biodiversity Science-Constraints of Biodiversity Science

1.2 Genetic Diversity-Nature and origin of Genetic Diversity-Measurement of Genetic Diversity-Methods Based on DNA and Chromosomes

1.3 Species Diversity : Wild Taxa

1.4 Introduction Species Inventory

1.5 Species of Microbes and Plants – Viruses-Bacteria -Fungi and Lichens –Algae – Bryophytes – Pteridophytes – Gymnosperms-Angiosperms

1.6 History and Origin of species diversity

Unit II - Values and Uses of Biodiversity **18 Hours**

2.1 Biodiversity Values - Ethical and Aesthetic values

2.2 Precautionary principle

2.3 Methodologies for Valuation of Biodiversity

2.4 Uses of Plants – Food – Timber-Rattans and Canes-Medicinal Plants-Ornamentals -Other uses

2.5 Uses of Microbes

Unit III - Loss of Biodiversity **18 Hours**

3.1 Loss of Genetic Diversity
3.2 Loss of Species Diversity
3.3 Threatened species -IUCN threatened Species-Census of threatened Species-Common features of threatened Species
3.4 Loss of Ecosystem Diversity
3.5 Loss of Agrobiodiversity

Unit IV - Conservation of Biodiversity **18 Hours**

4.1 Current Practice in Conservation
4.2 In-situ and ex-situ Conservation
4.3 Introduction to Biodiversity Management
4.4 Methodologies for Execution – IUCN – UNEP – UNESCO – WWF – ICSU-FAO
4.5 Biodiversity Legislation Conventions-International Biodiversity Laws-Ramsar Convention-Plant Collection and Trade Controls

Unit V - Biodiversity Information : management and Communication18 Hours

5.1 Libraries
5.2 Bibliographics
5.3 Periodicals
5.4 Databases-Taxonomic Database–metadatabases-Virtual libraries-Biodiversity application software-Directories of Biodiversity Data Sources
5.5 Catalogues and Indexes of plant and microbial data
5.6 Biotechnology and its role in Biodiversity Conservation
5.7 IPR and ownership of Traditional Knowledge

B. Topics for Self Study

S.No	Topics	Weblinks
1	Human Impact of fisheries	https://nptel.ac.in/courses/120/108/120108002/
2	Wild life conservation	https://onlinecourses.nptel.ac.in/noc20_bt39/preview
3	Ethno medicinal plants conservation	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3793161/
4	Human Impact of fisheries	https://nptel.ac.in/courses/120/108/120108002/
5	Biodiversity, population and ecological principles	https://www.youtube.com/watch?v=hihFHam_wNE

C. Text Book(s)

1. K.V Krishnamurthy, An Advanced Textbook on Biodiversity Principle and Practice, Oxford and IBH Publishing, 2004 ISBN: 978812041606-2

D. Reference Book(s)

1. I.Sundar, Biodiversity Conservation and Sustainable Development , Serials Publication, 2010 ISBN 978-81-8387-410-6.
2. T.R Sabu and P.K .Sabu Biodiversity and Sustainable Utilization of Biological Resources, Scientific Publishers, 2019, ISBN 978-81-87913-68-4.
3. Samit Ray and ArunK.Ray, Biodiversity &Biotechnology,New Central Book Agency (P) Ltd,2010, ISBN 81-7381-505-4

E. Weblinks

1. https://www.youtube.com/watch?v=SHxAOoxhKTA
2. https://www.youtube.com/watch?v=Umxi09vUlYU
3. https://www.youtube.com/watch?v=hihFHam_wNE

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Biodiversity Science**		
1.1	1.1 Introduction to Biodiversity Biodiversity –concept and definition Scope of Biodiversity Science Constraints of Biodiversity Science 1.2 Genetic Diversity 1.2.1 Nature and origin of Genetic Diversity 1.2.2Measurement of Genetic Diversity 1.2.3 Methods Based on DNA and Chromosomes 1.3 Species Diversity : Wild Taxa	Explain the Role of Biodiversity in day to day life	K2
1.2 1.3	Genetic Diversity Nature and origin of Genetic Diversity Measurement of Genetic Diversity Methods Based on DNA and Chromosomes Species Diversity : Wild Taxa	Summarize the scope of Biodiversity informatics Classify the types of Biodiversity	K2
1.4 1.5	1.4 Introduction Species Inventory 1.5 Species of Microbes and Plants -Viruses,Bacteria,Fungi and Lichens,Algae, Bryophytes,Pteridophytes, Gymnosperms, Angiosperms	Recall the knowledge of flora, fauna and microorganisms	K1

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1.6	History and Origin of species diversity	Define Species Diversity	K1
2	**Values and Uses of Biodiversity**		
2.1 2.2 2.3	2.1 Biodiversity Values -Ethical and Aesthetic values Precautionary principle Methodologies for Valuation of Biodiversity	Summarize the Values and uses of Biodiversity	K2
2.4	2.4 Uses of Plants 2.4.1 Food 2.4.2 Timber 2.4.3 Rattans and Canes	Summarize the Values and uses of Biodiversity	K2
2.5	2.4.4 Medicinal Plants 2.4.5 Ornamentals 2.4.6 Other uses 2.5 Uses of Microbes	Identify the various plant products that are helpful to humans	K2
3	**Loss of Biodiversity**		
3.1 3.2	Loss of Genetic Diversity Loss of Species Diversity	Distinguish between Genetic and Species Diversity	K4
3.3	Threatened species IUCN threatened Species Census of threatened Species Common features of threatened Species	List out the threatened Species in India	K1
3.4	Loss of Ecosystem Diversity Loss of Agrobiodiversity	Inspect the loss of Ecosystem Diversity	K4
4	**Conservation of Biodiversity**		
4.1 4.2	Current Practice in Conservation In-situ and ex-situ Conservation	Recall the methods of Conservation of Biodiversity	K1
4.3	Introduction to Biodiversity Management	Analyze the strategies of Biodiversity Management	K4
4.4	4.4 Methodologies for Execution IUCN UNEP UNESCO WWF ICSU FAO	Review the role of the different Biodiversity Conservation organizations	K2
4.5	Biodiversity Legislation Conventions - International Biodiversity Laws	Recall the national and international Biodiversity laws	K1

Unit/ Section	Course Content	Learning Outcomes	HBTLT
	Ramsar Convention -Plant Collection and Trade Controls	DescribeRamsar Convention Discuss the plant collection and Trade controls	K2 K2
5	**Biodiversity Information : management and Communication**		
5.1	Biodiversity Information management and Communication	Define Biodiversity management	K1
5.2 5.3 5.4 5.5	Libraries Bibliographics Periodicals Databases Taxonomic Database Metadatabase Virtual libraries Biodiversity application software Directories of Biodiversity Data Sources	List out the Databases available for Biodiversity information	K1
5.6	Catalogues and Indexes of plant and microbial data	Applications of Plant and Microbial Databases	K3
5.7	Biotechnology and its role in Biodiversity Conservation	Discuss the role of Biotechnology in Biodiversity Conservation	K2
5.8	State the need ofTraditional Knowledge in IPR	State the need ofTraditional Knowledge in IPR	K1

4. Mapping Scheme

I20BI6:1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	-	L	M	L	L	L	H	-	L	L
CO2	L	L	L	-	L	M	L	L	L	H	-	L	L
CO3	L	L	L	-	L	M	L	L	L	H	-	L	L
CO4	L	L	L	-	L	M	L	L	L	H	-	L	L
CO5	M	M	-	L	M	L	L	-	L	H	L	M	L
CO6	M	M	-	L	M	L	L	-	L	H	L	M	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Elective III : Immunoinformatics

Semester : VI **Course Code : I23BI6:B**

Credits : 3 **Hours / Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course outcomes	Level	Unit
CO1	Describe the antigen processing mechanism	K2	I
CO2	Discuss the different types of immune cells and its functions	K2	II
CO3	Explain the production of antibodies	K2	III
CO4	Describe the membrane receptors for antigen	K2	IV
CO5	Analyse the merits and demerits of vaccine designing	K4	IV
CO6	Discuss the basics of immunological databases	K2	V

2. A. Syllabus

Unit I - Immune systems and Systems biology **18 Hours**

1.1. Innate and adaptive immunity in vertebrates
1.2. Antigen processing and presentation.
1.3. Antibodies: Immunoglobulins, Immunoglobulin classes and subclasses, CDR and LDR regions and sequence numbering, Immunogenetics,
1.4. Hybridoma technology: applications and engineering, Humanization of antibodies by design.

Unit II - Membrane receptors for antigen **18 Hours**

2.1. The B-cell surface receptor for antigen (BCR), The Tcell surface receptor for antigen (TCR),
2.2. Antigen recognition diversity, the major histocompatibility complex (MHC).
2.3. Contemporary challenges to the immune system: Infectious diseases, clustering of infectious disease organisms, autoimmune diseases.
2.4. Epitopes: Affinity Maturation, Recognition of Antigen by B cells,
2.5. Neutralizing Antibody, Prediction of epitopes.

Unit III - Vaccine design **18 Hours**

3.1. Categories of vaccines, Polytope vaccines, Therapeutic vaccines, Evolution and escape due to variations.

3.2. HLA, immunogenomics and viral bioinformatics,

3.3. Generating data for databases -the peptide repertoire of HLA molecules, HLA nomenclature and IMGT/HLA sequence database.

Unit IV - Mathematical models **18 Hours**

4.1. Reverse immunology and approaches in computer aided vaccine design,

4.2. Viral bioinformatics: computational views of host and pathogen.

4.3. MHC polymorphism: Causes of MHC polymorphism, MHC supertypes

Unit V - Browsing and searching immunological databases **18 Hours**

5.1. Immunoglobulin: sequence and structure,

5.2. Databases of epitopes. Antibody: Antibody numbering, Prediction of 3D structure using homology modeling,

5.3. Sequence analysis in immunology: Alignments, Molecular evolution and phylogeny,

5.4. Prediction of functional features of biological sequences.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Vaccine Designing	https://www.youtube.com/watch?v=wwfq0UHhyQU
2	Innate and Adaptive immunity	https://nptel.ac.in/courses/102/105/102105083/
3	Structural variation in immunoglobulin	https://nptel.ac.in/courses/102/105/102105083/
4	Antigen Recognition by T-cell	https://nptel.ac.in/courses/102/105/102105083/
5	Tools and Techniques in immunology	https://nptel.ac.in/courses/102/105/102105083/

C. Text Book(s)

1. Christian Schönbach, Shoba Ranganathan, Vladimir Brusic, Immunoinformatics, 2007.

D. Reference Book(s)

1. Ole Lund, Morten Nielsen, Claus Lundegaard, Can Kesmir, and Soren Brnak, Immunological Bioinformatics, The MIT press, 2005.

2. Immunoinformatics: Bioinformatics Strategies for Better Understanding of Immune Function, Wiley; 1st Edition, 2003.

3. Ivan M. Roitt and Peter J. Delves , Essential Immunology, Wiley-Blackwell , 2011

E. Weblinks

1. https://www.youtube.com/watch?v=48Xr-H05raA
2. https://www.youtube.com/watch?v=BNvb3zBRsrY
3. https://www.youtube.com/watch?v=6QSteXSTXes

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Immune systems and Systems biology		
1.1	Innate and adaptive immunity in vertebrates	Define the adaptive immunity in vertebrates	K1
1.2	Antigen processing and presentation	Discuss the antigen processing and presentation	K2
1.3	Antibodies: Immunoglobulins, Immunoglobulin classes and subclasses, CDR and LDR regions and sequence numbering, Immunogenetics	Explain the immunoglobulins, Immunoglobulin classes and subclasses, CDR and LDR regions	K2
1.4	Hybridoma technology: applications and engineering, Humanization of antibodies by design.	Summarize the hybridoma technology and its applications.	K2
2	Membrane receptors for antigen		
2.1	The B-cell surface receptor for antigen (BCR), The Tcell surface receptor for antigen (TCR)	Discuss the B-cell and T cell surface receptors for antigen	K2
2.2	Antigen recognition diversity, the major histocompatibility complex (MHC)	Discuss the antigen recognition diversity, the major histocompatibility complex	K2
2.3	Contemporary challenges to the immune system: Infectious diseases, clustering of infectious disease organisms, autoimmune diseases.	Tell thepathogenesisofinfectious diseasesandautoimmune diseases	K2
2.4	Epitopes: Affinity Maturation, Recognition of Antigen by B cells	Explain the epitopes affinity maturation, recognition of antigen by B cells	K2
2.5	Neutralizing Antibody, Prediction of epitopes	Demonstrate the steps involved in neutralizing antibody, prediction of epitopes	K3
3	Vaccine design		
3.1	Categories of vaccines, Polytope vaccines, Therapeutic vaccines, Evolution and escape due to variations.	Classify vaccines based on their preparation and production.	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3.2	HLA, immunogenomics and viral bioinformatics	Explain the HLA, immunogenomics and viral bioinformatics	K2
3.3	Generating data for databases -the peptide repertoire of HLA molecules, HLA nomenclature and IMGT/HLA sequence database	Discuss the peptide repertoire of HLA molecules, HLA nomenclature and IMGT/HLA sequence database	K2
4	**Mathematical models**		
4.1	Reverse immunology and approaches in computer aided vaccine design	Identify the reverse immunology and approaches in computer aided vaccine design	K2
4.2	Viral bioinformatics: computational views of host and pathogen	Explain the viral bioinformatics computational views of host and pathogen	K2
4.3	MHC polymorphism: Causes of MHC polymorphism, MHC super types	Analyze the MHC polymorphism: causes of MHC polymorphism, MHC super types	K4
5	**Browsing and searching immunological databases**		
5.1	Immunoglobulin: sequence and structure	Explain the immunoglobulin structure	K2
5.2	Databases of epitopes. Antibody: Antibody numbering, Prediction of 3D structure using homology modeling	Demonstrate the steps involved in predicting the 3D structure of antibodies using homology modeling	K3
5.3	Sequence analysis in immunology: Alignments, Molecular evolution and phylogeny	Apply the concepts of sequence analysis, alignments, Molecular evolution and phylogeny in immunology	K3
5.4	Prediction of functional features of biological sequences	Summarize the functional features of biological sequences	K2

4. Mapping Scheme

I20BI6:2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	-	M	-	-	L	L	-	L	L	M	L
CO2	M	M	L	L	L	L	L	-	-	H	H	L	-
CO3	M	M	L	L	L	L	L	-	-	M	-	-	M
CO4	M	M	L	L	L	L	L	-	-	H	-	-	M
CO5	H	L	L	M	-	M	L	L	L	L	M	H	M
CO6	H	L	L	M	-	M	L	L	L	L	M	H	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

Elective -IV: INTRODUCTION TO INTERNET OF THINGS & ITS APPLICATIONS

Semester:VI **Course Code: I23BI6:C**

Credits:3 **Total Hours:5**

COURSE OUTCOMES

After completion of this course, the students will be able to

S.No	Course Outcomes	Blooms Taxonomic levels of Transaction	Units Covered
CO1	Understand the basics of IoT.	K1	I
CO2	Implement the state of the Architecture of an IoT.	K3	II
CO3	Understand design methodology and hardware platforms involved in IoT.	K2	III
CO4	Understand how to analyze and organize the data.	K2	IV
CO5	Compare IOT Applications in Industrial & realworld.	K4	IV & V
CO6	Apply the knowledge in developing models for home applications	K2	V

UNITI: FUNDAMENTALS OF IoT

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II: IoT PROTOCOLS

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT III: DESIGN AND DEVELOPMENT

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details

UNIT IV: DATA ANALYTICS AND SUPPORTING SERVICES:

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M,

Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT V: CASE STUDIES/INDUSTRIAL APPLICATIONS: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments, Industry 4.0 concepts.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill HigherEducation

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition,Michael Margolis,Arduino Cookbook and O"Reilly Media,2011.

Elective -IV: MACHINE LEARNING IN BIOINFORMATICS

Semester:VI **Course Code: I23BI6:D**

Credits: 3 **Total Hours: 5**

COURSE OUTCOMES

After completion of this course, the students will be able to

S.No	Course Outcomes	Blooms Taxonomic levels of Transaction	Units Covered
CO1	Explain the basic outline of machine learning theories and methods.	K2	I
CO2	Apply the machine learning to biological sequence analysis, gene expression data analysis.	K2	II
CO3	Provide the details about machine learning algorithms and applications.	K3	III
CO4	Describe the aspects about machine learning in structure prediction.	K3	IV
CO5	Gain the knowledge to develop machine learning methods for proteins, DNA and RNA.	K4	IV
CO6	Explain the facts about the models for phylogeny	K3	V

UNIT-I INTRODUCTION

Introduction-Bayesian modeling-Cox Jaynes axioms- Bayesian inference and induction models structures-examples. Machine learning applications in genetics and genomics.

UNIT-II DYNAMIC PROGRAMMING

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

UNIT-III STRUCTURE PREDICTION

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

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

UNIT-V PHYLOGENTIC ANALYSIS

Models for phylogeny-substitution probabilities-Data likelihood-optimal trees- modeling for array data

TEXT BOOKS:

1. Soren 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.
3. Balas Kausik Natarajan, Machine Learning: A Theoretical Approach, Morgan Kaufmann, 1991.

4. Yi-Ping Phoebe. Chen, Bioinformatics Technologies, Springer, 2005. 149

WEB RESOURCE LINK

➢ bioinformaticsalgorithms.com

➢ https://www.elsevier.com/books/bioinformatics-algorithms/

➢ https://www.coursera.org/specializations/bioinformatics

PCS: PROFESSIONAL COMPETENCY TO CLEAR COMPETETIVE EXAMINATIONS

(For the Candidates Admitted from 2023 onwards Under TANSCHE Revised Syllabus)

SEMESTER : VI **COURSE CODE : I23BI6G1**

CREDITS : 3 **HOURS/ WEEK: 5**

1. COURSE OUTCOMES

After Completion of this course, the students will be able to

S.No	Course Outcomes	Blooms Taxonomic Levels of Transaction	Units Covered
CO 1	Understand and solve puzzle related questions from specific and other competitive tests	K2	I & II
CO 2	Relate the logical thinking and analytical abilities to solve Quantitative aptitude	K2	II
CO 3	Interpret the concepts of logical reasoning skills	K2	II & III
CO 4	Solve the real time problems involving mathematical operations	K3	III
CO 5	Acquire the basic concepts of physical chemical and biological sciences	K4	IV
CO 6	Identify the relevant current affairs of India for clearing competitive examinations	K3	V

2. Syllabus

Unit -I : Basic Aptitude and Mental Ability

(i) Simplification – Percentage - Highest Common Factor (HCF) - Lowest Common Multiple (LCM).

(ii) Ratio and Proportion.

(iii) Simple interest - Compound interest - Area - Volume – Time and Work.

(iv) Logical Reasoning - Puzzles-Dice - Visual Reasoning – Alpha numeric Reasoning- Number Series

Unit – II : Logical Thinking

(i) Basic Concept of Logic – types of propositions – methods and rules for reducing propositions – inference – inductive, deductive inference – methods and rules for solving inferences.

(ii) Rules and concept of inversion

Unit – III : Analytical Thinking

(i) Input/Output Problems – Problems dealing with recording – problems involving mathematical operations.

(ii) Concept of Binary Number – convert binary to decimal – decimal to binary numbers

Unit – IV : Key Concepts in Basic and Life Sciences

(i) Scientific Knowledge and Scientific Temper - Power of Reasoning - Rote Learning vs Conceptual Learning - Science as a tool to understand the past, present and future.

(ii) Elements and Compounds, Acids, Bases, Salts, Petroleum Products, Fertilizers, Pesticides.

(iii) Main concepts of Life Science, Classification of Living organisms, Evolution, Genetics, Physiology, Nutrition, Health and Hygiene, Human Diseases.

Unit – V : Current Affairs of India

(i) History - Latest diary of events - National symbols - Profile of States - Eminent personalities and places in news – Sports - Books and authors.

(ii) Polity - Political parties and political system in India – Public awareness and General administration - Welfare oriented Government schemes and their utility, Problems in Public Delivery Systems.

3. Reference Books

1.Analytical Reasoning – MK Pandey -BSc Publishing Pvt Ltd ,5th Edition (2019)

2.Logical and analytical Reasoning – R.Guptha's Ramesh Publishing House , Delhi – 4th Edition 2019.

3.A Modern Approaches to Logical Reasoning -RS Aggarwal – S Chand Publishing – Delhi 1 (Edition -2018)

4.Non Verbal Reasoning - RS Aggarwal – S Chand Publishing – Delhi – 1 (Edition - 2018)

5.UPSC Indian Civil Services (Prelims CSAT Paper II)Arahant Publishing(P) Ltd (2018)- Dhiraj Pandey

Programme: M.Sc., BIOINFORMATICS (INTEGRATED) (2023-2024)
Course Structure

Sem.	Course	Course Title	CourseCode	Hours /week	Credits	Marks		
						CIA	ESE	Total
VII	Core IX	Algorithm for Computational Biology	I23BI709	5	5	25	75	100
	Core X	Programming in JAVA	I23BI710	5	5	25	75	100
	Core XI	Bioinformatics Database and Tools	I23BI711	5	5	25	75	100
	Core Prac. IX	Programming in Java Lab	I23BI7P9	5	3	40	60	100
	Core Prac. X	Bioinformatics Database and Tools Lab	I23BIP10	5	3	40	60	100
	Elective IV	Protein Structure and functions/ Molecular Interactions	I23BI7:A/ I23BI7:B	5	3	25	75	100
			Sem.VII Credits:	30	24			
VIII	Core XII	R Programming for Bioinformatics	I23BI812	5	5	25	75	100
	Core XIII	Probability and Biomathematics	I23BI813	5	5	25	75	100
	Core XIV	Principles of Drug design and Development	I23BI814	5	5	25	75	100
	Core Prac. XI	Computational Biology, Bio-Statistics using R and Drug Designing Lab	I23BIP11	5	3	40	60	100
	Elective V	Basics of Next Generation Sequencing (Industry Module) /Herbal Medicine	I23BI8:A/ I23BI8:B	5	4	25	75	100
	Elective VI	Systems Biology/ Research Methodology, Bioethics, Biosafetyand IPR	I23BI8:C/ I23BI8:D	5	4	25	75	100
			Sem.VIII Credits	30	26			
IX	Core XV	Genomics and Proteomics	I23BI915	5	5	25	75	100
	Core XVI	Advances in Structural Bioinformatics	I23BI916	5	5	25	75	100
	Core XVII	Advanced Programming in Python (Industry Module)	I23BI917	5	4	25	75	100
	Core Prac. XII	Advances in Structural Bioinformatics Lab	I23BIP12	5	3	40	60	100
	Core Prac. XIII	Advanced Programming in Python Lab	I22BIP13	5	3	40	60	100
	Elective VII	Cheminformatics / Data Mining and Designing	I23BI9:A/ I23BI9:B	4	3	25	75	100
	GenericCourse 1	Scientific writing and research publication ethics	I23BI9E2	1	1			100
		Internship/ Skill Development Course for Clearing Competitive Examinations	I23BI9F1		2			
			Sem.IX Credits :	30	26			
X	Core XVIII	Pharmacoinformatics	I23BIX18	5	5	25	75	100
	Elective VIII	Big Data Analytics for Bioinformatics/ Application of Bioinformatics in Applied Biology	I23BIX:A/ I23BIX:B	5	4	25	75	100
	Core Project- II	Project	I23BIXPJ	20	6	60	240	300
			Sem.X Credits :	10	15			
		Total Credits :			91			
Core Theory : 10 Core Practicals : 5 Core Project : 1 Elective : 5						Total :		21

Structure of the Curriculum for M.Sc Bioinformatics
(2022 - 2023)

Parts of the Curriculum	No. of Courses	No. of Hours	Credits	Total Credits
Major				
Core(Theory)	10	50	50	69
Core(Practical)	5	25	15	
Core(Project)	1	-	6	
Elective(Theory)	5	23	20	20
Total	**21**	**100**	**91**	**91**

Total Courses : 21

Total Credits : 91

Total Hours : 100

PROGRAMME ARTICULATION MATRIX
M.Sc., Bioinformatics (Integrated) Programme (2022–2023 onwards)

S. No	COURSE NAME	Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
1	Algorithm for Computational Biology	I23BI709	H	M	L	L	M	L	-	-	L	M	M	L	M
2	Programming in JAVA	I23BI710	H	H	L	M	H	L	L	-	-	H	M	L	H
3	Bioinformatics Database and Tools	I23BI711	M	M	M	L	H	L	-	-	-	M	L	M	M
4	Programming in Java Lab	I23BI7P9	H	H	L	L	L	L	-	-	-	H	M	M	H
5	Bioinformatics Database and Tools Lab	I23BIP10	H	M	M	L	M	L	L	-	-	H	M	L	M
6	Protein Structure and functions	I23BI7:A	M	H	L	M	M	L	-	-	M	M	M	M	M
6.a	Molecular Interactions	I23BI7:B	H	H	L	L	M	L	-	-	-	H	M	L	M
7	R Programming for Bioinformatics	I23BI812	H	H	M	L	M	L	L	-	-	H	-	L	M
8	Probability and Biomathematics	I23BI813	M	M	L	M	L	M	-	-	M	H	L	L	M
9	Principles of Drug design and Development	I23BI814	M	H	M	L	M	L	-	-	-	M	-	M	M
10	Computational Biology, Bio-Statistics using R and Drug Designing Lab	I23BIP11	M	H	L	L	M	L	-	-	-	H	-	M	H
11	Basics of Next Generation Sequencing	I23BI8:A	M	M	L	M	L	L	-	-	M	H	-	L	M
11. a	Herbal Medicine	I23BI8:B	H	H	M	L	M	L	L	-	-	H	L	L	M
12	Systems Biology	I23BI8:C	M	M	L	L	M	M	-	-	-	M	-	L	H
12. a	Research Methodology, Bioethics, Biosafety and IPR	I23BI8:D	M	H	L	L	M	L	-	-	-	H	-	M	M
13	Genomics and Proteomics	I23BI915	H	H	M	M	L	L	-	M	-	H	M	M	H

S. No	COURSE NAME	Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
14	Advance in Structural Bioinformatics	I23BI916	M	M	L	L	M	L	-	-	M	H	-	L	M
15	Advanced Programming in Python	I23BI917	H	H	M	L	M	L	-	-	M	H	M	L	M
16	Advances in Structural Bioinformatics Lab	I23BIP12	M	H	L	M	M	L	L	-	-	H	M	M	H
17	Advanced Programming in Python Lab	I22BIP13	H	M	L	L	M	L	-	-	-	H	M	L	M
18	Cheminformatics	I23BI9:A	H	H	L	L	L	L	-	-	M	M	M	L	M
18. a	Biodiversity, Bioethics and IPR	I23BI9:B	M	H	M	M	M	-	L	-	-	H	-	M	H
19	Pharmacoinformatics	I23BIX18	H	M	L	L	M	L	-	-	-	H	-	L	M
20	Big Data Analytics for Bioinformatics	I23BIX:A	H	H	M	M	M	M	-	-	-	M	-	L	H
20. a	Elec Viii: Application Of Bioinformatics in Applied Biology	I23BIX:B	H	M	L	L	M	M	-	-	-	H	-	M	M

Should be marked on H – M - L Scale

Core IX : Algorithm for Computational Biology

Semester : VII **Course Code : I23BI709**

Credits : 5 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Explain the various algorithms used for pairwise sequence analysis	K2	I
CO2	Discuss the concepts and algorithms in multiple sequence alignment	K2	II
CO3	Analyze the methods used for phylogenetic tree construction	K4	II
CO4	Relate the role of the various tools used in genome comparison	K4	III
CO5	Employ various structure determination technique to study macromolecules	K3	IV
CO6	Design the computational methods used for Protein structure prediction	K5	V

2. A. Syllabus

Unit I –Pairwise Sequence Analysis **15 Hours**

1.1. Sequence Alignment - Similarity vs Homology - Homologs, Hetrologs, analogs, orthologs, paralogs, xenologs - Significance of an alignment

1.2. Dot matrices and hash coding - Comparing sequences using dot matrices - Pattern searching using hash coding

1.3. Dynamic programming in sequence alignment - Needleman - Wunch algorithm - Smith –Waterman algorithm

1.4. BLAST and FASTA

Unit II –Multiple Sequence Analysis **15 Hours**

2.1. Multiple sequence alignment (MSA) - Goals of MSA and representation of MSA - Scoring of MSA - Progressive or hierarchical alignment

2.2. Substitution matrices - Evolutionary models - PAM and BLOSUM substitution matrices - Gap penalties.

2.3. Introduction to Phylogenetic tree - Distance matrix methods-UPGMA, NJ, Maximum parsimony, Maximum likelihood

Unit III –Genome & Gene Comparison **15 Hours**

3.1. Pattern representing and characterization - Deterministic pattern-regular expression - Probabilistic patterns-sequence logos - Pattern characterization and classification

3.2. Pattern discovery and sequence classification in proteins - General methods - Hidden Markov models - Other analysis of protein sequences

3.3. Pattern discovery and sequence classification in Nucleic acids - Gene discovery - Gene discovery using HMM-GenMark, ANN-GRAIL, Fourier analysis-GeneScan .

Unit IV –Macromolecular Techniques **15 Hours**

4.1. Experimental structure determination techniques - X-ray crystallography, NMR, Electron microscopy

4.2. Visualisation and representation of molecular structures

4.3. Geometrical analysis of structure

4.4. Structure comparison

Unit V –Protein Structure Prediction & Folding **15 Hours**

5.1. Prediction of secondary structure prediction - 5.1.1 Measures of prediction accuracy - Statistical techniques-CF algorithm, GOR, Neural Network in secondary structure prediction-PHD, Nearestneighbour methods-PREDATOR, NNSSP, Consensus methods-JPRED, NPS

5.2. Protein tertiary structure prediction-Homology modeling, Threading, Ab initio structure prediction5.3 Protein folding

B. Topics for Self Study

S.No.	Topics	Web Links
1	Representation of biological network	https://nptel.ac.in/courses/102/106/102106068/
2	Network biology	https://nptel.ac.in/courses/102/106/102106068/
3	Reconstruction of protein network	https://www.youtube.com/watch?v=yyf-mEQ2QCI&feature=emb_logo
4	Metabolic network applications	https://www.youtube.com/watch?v=8-gQu56ZrNE&feature=emb_logo

C. Text Book(s)

1. Gautham N, Bioinformatics Database and Algorithms, Narosa publishing House. 2009.

D. Reference Book(s)

1. David W Mount, Bioinformatics : Sequence and Genome Analysis , Cold Spring Harbor Laboratory Press, New York.2004.
2. Baxevanis, A.D. and Francis Ouellellette B.F, Bioinformatics –a Practical Guide to the Analysis of Genes and Proteins , Wiley India Pvt Ltd .2009.

E. Weblinks

1. https://onlinecourses.nptel.ac.in/noc20_bt08/preview
2. https://nptel.ac.in/courses/102/106/102106065/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Pairwise Sequence Analysis**		
1.1	Sequence alignment	Compare Similarity with Homology	K2
		Discuss the significance of sequence alignment	K2
1.2	Dot matrices and hash coding	Compare the sequences using dot matrices	K2
		Perform Pattern searching using hash coding	K3
1.3	Dynamic programming in sequence alignment	Demonstrate Needleman - Wunch and Smith – Waterman algorithm	K3
		Differentiate BLAST and FASTA	K4
2	**Multiple Sequence Analysis**		
2.1	Multiple sequence alignment (MSA)	Explain the MSA concept	K2
		Demonstrate progressive and hierarchical alignment	K3
2.2	Substitution matrices	Distinguish PAM and BLOSUM matrices	K4
2.3	Introduction to Phylogenetic tree	Apply the distance matrix to explain phylogenetic tree	K3
		Assess the distance matrix methods-UPGMA, NJ, Maximum parsimony, Maximum likelihood	K6
3	**Genome & Gene Comparison**		
3.1	Pattern representing and characterization	Relate the probabilistic patterns with sequence logos	K4
		Analyze the sequence to predict the pattern	K4
		Discuss the general methods used in pattern discovery	K2
3.2	Pattern discovery and sequence classification in proteins	Locate the conserved regions using HMM algorithm	K3
		Discuss the methods of gene discovery	K2
3.3	Pattern discovery and sequence classification in Nucleic acids	Demonstrate the tools used for gene discovery	K3

Unit/ Section	Course Content	Learning Outcomes	HBTLT
4	**Macromolecular Techniques**		
4.1	Experimental structure determination techniques	Employ methods like X-ray crystallography, NMR, Electron microscopy to predict the macromolecular structures	K3
4.2 & 4.3	Visualization and representation of molecular structures, Geometrical analysis of structure	Identify the techniques used for structure visualization and representation	K2
4.4	Structure comparison	Review on structure comparison methods	K6
5	**Protein Structure Prediction & Folding**		
5.1	Prediction of secondary structure	Analyze the methods used for protein secondary structure prediction and its accuracy	K4
		Categorize the tools used for protein secondary structure prediction	K4
5.2	protein tertiary structure prediction	Assess the following methods Homology modeling, Threading, Ab initio for protein 3D structure prediction	K6
5.3	Protein folding	Investigate the significance of protein folding	K6

4. Mapping Scheme

I23BI709	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	M	H	M	-	-	L	L	M	M	H	H
CO2	M	L	M	H	M	-	-	L	L	M	M	H	H
CO3	M	L	M	H	M	-	-	L	L	M	M	H	H
CO4	H	L	L	L	M	L	-	L	L	H	M	M	M
CO5	H	L	L	L	M	L	L	L	L	M	M	M	L
CO6	H	H	M	M	M	L	M	H	-	H	M	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Core X : Programming In JAVA

Semester : VII **Course Code : I23BI710**

Credits : 5 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Apply the concepts of Object Oriented Programming	K3	I
CO2	Develop Console applications in Text editor	K6	II
CO3	Adapt multithreading in real time console applications	K6	III
CO4	Design windows application in java and explain the use of Exception handling	K6	IV
CO5	Develop applications using files in console application and windows application	K6	IV
CO6	Construct applications with string handling in real-time applications	K6	V

2. A. Syllabus

Unit I - Overview of Java and Introduction to Object Oriented Programming **15 Hours**

1.1. The History and Evolution of Java
1.2. An Overview of Java
1.3. Data types
1.4. Variables
1.5. Arrays
1.6. Operators
1.7. Control Statements
1.8. Introducing Classes
1.9. A Closer look at Methods and Classes

Unit II - Object Oriented Programming Principles in depth **15 Hours**

2.1. Inheritance
2.2. Using super
2.3. Using final with Inheritance
2.4. Packages and Interfaces
2.5. Exception Handling

2.6. Multithreaded Programming
2.7. Enumerations

Unit III - String Handling in Java **15 Hours**

3.1. I/O Try with resources
3.2. String Handling
3.3. Exploring java.lang

Unit IV - Utilities Package and I/O **15 Hours**

4.1. java.util Part 1: The Collections Framework
4.2. Input / Output : Exploring java.io

Unit V - Event Handling and AWT **15 Hours**

5.1. Event handling: The Delegation Event model
5.2. Introducing the AWT : Working with Windows
5.3. Introducing Swing
5.4. Exploring Swing
5.5. Introducing Swing Menus
5.6 . Java Database Connectivity

B. Topics for Self Study

S.No	Topics	Web links
1	DevOps	https://www.devopsschool.com/courses/agenda/devops/devops-training-course-Java.html
2	Git and Github	https://idratherbewriting.com/java-share-files/
3	Spring Framework 5	https://www.journaldev.com/20714/spring-5
4	RESTful Web Service	https://docs.oracle.com/javaee/6/tutorial/doc/gijqy.html

C. Text Book(s)

1. Herbert Schildt, Java The Complete Reference (11 th Edition), McGraw Hill Education, 2018.

D. Reference Book(s)

1. Balagurusamy, E, Programming with Java, Tata McGraw Hill, Education Pvt Ltd, 5th Edition, 2015
2. Eckel Bruce, Thinking in Java for Java SE5/6, Pearson, 4th Edition, 2013.

E. Weblinks

1. https://www.javatpoint.com/java-tutorial
2. https://www.w3schools.com/java/java_intro.asp
3. https://www.oracle.com/topics/technologies/newtojava/ programming-center.html
4. https://www.tutorialspoint.com/java/index.htm
5. https://www.codecademy.com/learn/learn-java

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Overview of Java and Introduction to Object Oriented Programming**		
1.1	The History and Evolution of Java	Summarize the impact of Java in Internet	K2
1.2	An Overview of Java	Explain Object Oriented Programming Concepts	K2
1.3	Data types	Select appropriate data types for declaring variables	K3
1.4	Variables	Illustrate the use of variables	K2
1.5	Arrays	Make use of arrays to store collections	K3
1.6	Operators	Demonstrate operators by developing console applications	K2
1.7	Control Statements	Apply control statements and iterations	K3
1.8	Introducing Classes	Develop console applications using OOP principles	K3
1.9	A Closer look at Methods and Classes	Construct Java application with Overloading concept	K6
2	**Object Oriented Programming Principles in depth**		
2.1	Inheritance: Inheritance Basics	Create Java application using keywords such as abstract, final, extends	K6
2.2	Using super	Build Java application by using inheritance concept	K6
2.3	Using final with Inheritance	Choose final keyword to restrict inheriting a class or method	K6
2.4	Packages and Interfaces	Design Java application using packages and interfaces	K6
2.5	Exception Handling	Improve java application with exception handling	K6
2.6	Multithreaded Programming	Construct multithreaded java application	K6
2.7	Enumerations	Choose correct enumerations in developing Java application	K5
3	**String Handling in Java**		
3.1	I/O Try with resources	Experiment with Console I/P	K3

Unit/ Section	Course Content	Learning Outcomes	HBTLT
3.2	String Handling	Develop Java application using String handling functions	K6
3.3	Exploring java.lang	Create application using the built-in functions in java.util package	K6
4	**Utilities Package and I/O**		
4.1	java.util Part 1: The Collections Framework	Analyze the use of Maps in java	K4
4.3	Input / Output : Exploring java.io	Function with files for reading and writing I/O	K3
5	**Event Handling and AWT**		
5.1	**Event handling:** The Delegation Event model	Develop windows application with UI and event handlers	K6
5.2	**Introducing the AWT :** Working with Windows	Build a windows application with the controls and Layouts	K6
5.3	Introducing Swing	Discuss the UI controls	K6
5.4	Exploring Swing	Create windows application using Swing controls	K6
5.5	Introducing Swing Menus	Design an application with menus	K6
5.6	Java Database Connectivity	Utilize the database connectivity in windows application	K3

4. Mapping Scheme

I20BI710	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core XI : Bioinformatics Database & Tools

Semester : VII **Course Code : I23BI711**

Credits : 5 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Discuss the storage and organization of biological data	K2	I
CO2	Classify the different types of mapping Databases	K2	II
CO3	Use Genomic databases for various research in life sciences	K3	III
CO4	Use the appropriate tools to predict the secondary structure of a protein sequence of interest	K3	IV
CO5	Distinguish between good, medium and poor quality of a protein structure	K4	V
CO6	Create the 3D structure of a protein using various protein structure prediction methods	K5	V

2. A. Syllabus

Unit I - Biological Databases **15 Hours**

1.1 Introduction to Biological databases, 1.1.1 Types of database-1.1.2 Relational Databases-1.1.3 Object oriented databases-1.1.4 BiologicalDatabases

1.2 Primary Databases-GenBank, EMBL, DDBJ,PIR, UniProt,

1.3 Secondary Databases

1.4 Specialized Databases- Literature Databases: PubMed, OMIM.

Unit II - Mapping Databases **15 Hours**

2.1 Introduction to Mapping databases

2.2 relationship between mapping and sequencing

2.3 Genomic map elements-DNA Markers, Polymorphic Markers, DNA clones, Genomic annotations.

2.4 Types of Maps- Cytogenetic Maps, Genetic Linkage Maps, Physical Maps, STS content Maps, Clone-based maps, Radiation Hybrid Maps, Sequence based Maps

Unit III - Genome Databases **15 Hours**

3.1 Introduction to Genome Database-eGenome, LDB2000

3.2 Gene Integration Resources, GeneCards and GeneLoc, Genelynx, euGenes, AceView,

3.3 Comparative Maps.

3.4 Mouse Genome informatics Database, Rat Genome Database, UCSC, Ensembl.

Unit IV - Predictive methods using protein Sequences **15 Hours**

4.1 Introduction4.1.1 Predictive features of individual residues-

4.2 Secondary structure prediction-Prediction methods-PHDacc and PROfacc-Jpred.

4.3 Transmembrane segments-Prediction methods-TopPred, PHDhtm, ProfTMB, SOSUI, TMHMM and DAS.

4.3 Predicting Function-Annotation transfer-Motifs and patterns-Methods-PROSITE, Pfam, InterPro and BLOCKS.

4.4 Subcellular Localization-Prediction Methods-PSORT, SUBLOC, TargetP and LOC3D.

4.5 Functional Class-Prediction methods-EUCLID and ProtFun.

Unit V - Protein structure prediction and analysis **15 Hours**

5.1 Introduction-

5.2 Protein structure databases-Other structure databases-MSD, MMDB, PDBSum, TargetDB.

5.3 Visualizing Proteins-Three-Dimensional visualization packages.

5.4 Protein structure prediction-homology modeling-threading-Ab initio prediction.

5.5 Protein structure evaluation-DSSP-PROCHECK-VADAR-Verify3D.

5.6 Protein structure comparison.

B. Topics for Self Study

S.No.	Topics	Web Links
1	MOLGENIS research: advanced bioinformatics data software for non-bioinformaticians	https://academic.oup.com/bioinformatics/article/35/6/1076/5085379 https://doi.org/10.1093/bioinformatics/bty742
2	Gene mapping in plants and animals	http://eacharya.inflibnet.ac.in/data-server/eacharya-documents/55d44ff9e41301fd23d8facc_INFIEP_203/733/ET/203-733-ET-V1-S1_lec_31.pdf
3	Human Genome Project	www.nature.com/nature/supplements/collections/humangenome/commentaries/

S.No.	Topics	Web Links
4	Strategies for protein identification	https://nptel.ac.in/content/storage2/courses/102103017/pdf/lecture%2017.pdf
5	Protein Sequencing	https://nptel.ac.in/content/storage2/courses/102103017/pdf/lecture%2018.pdf

C. Text Book(s)

1. Jin Xiong, Essential Bioinformatics, Low Price Edition, Cambridge Press, 2019. (UNIT-I)
2. Baxevanis, A.D. and Francis Ouellellette, Bioinformatics a Practical Guide to the Analysis of Genes and Proteins, 3rdEdition,B.F.,Wiley India Pvt Ltd 2009.(UNIT-II, III, IV,& V)

D. Reference Book(s)

1. Mount D. Bioinformatics : Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York.2004.
2. Teresa K. Attwood, David J. Parry-Smith. Introduction to bioinformatics, Pearson Education,1999.

E. Weblinks

1. https://www.coursera.org/lecture/bioinformatics-pku/overview-of-resources-WlYAG
2. https://nptel.ac.in/courses/102/106/102106065/
3. https://onlinecourses-archive.nptel.ac.in/noc18_bt22/preview

3. Specific Learning Outcomes (SLO)

Unit/ Secton	Course Contents	Learning Outcomes	HBTLT
1	Biological Databases		
1.1	Introduction to Biological databases	Classify Biological Databases	K2
		Distinguish between Relational and Object oriented Database	K4
		Analyze and retrieve the sequences in Specialized databases	K4
1.2	Primary Databases-GenBank, EMBL, DDBJ,PIR, UniProt,	Summarize and classify the secondary database.	K4 K2
1.3	Secondary Databases	Explain Secondary Database	K2
1.4	Specialized Databases- Literature Databases: PubMed, OMIM.	Explain Specialized Database	K2

Unit/ Secton	Course Contents	Learning Outcomes	HBTLT
2	**Mapping Databases**		
2.1	Introduction to Mapping databases	Discuss the methods of mapping and sequencing.	K2
2.2	relationship between mapping and sequencing		
2.3	Genomic map elements-DNA Markers, Polymorphic Markers, DNA clones, Genomic annotations.	Analyze the importance of Markers	K4
2.4	Types of Maps	Compare Genetic and Physical map	K2
3	**Genome Databases**		
3.1	Introduction to Genome Database-eGenome, LDB2000	Explain the e-genome database	K2
3.2	Gene Integration Resources, GeneCards and GeneLoc, Genelynx, euGenes, AceView,	Demonstrate the various gene integration resources database.	K3
3.3 & 3.4	Comparative Maps. Mouse Genome informatics Database, Rat Genome Database, UCSC, Ensembl.	Demonstrate the mouse genome informatics database. Report on the significance of genome browser	K3 K6
4	**Predictive methods using protein Sequences**		
4.1 & 4.2	Predictive features of individual residues Secondary structure prediction-Prediction methods-PHDacc and PROfacc-Jpred.	Analyze the structure prediction methods	K4
4.3	Transmembrane segments-Prediction methods-TopPred, PHDhtm, ProfTMB, SOSUI, TMHMM and DAS.	Employ transmembrane tools to locate the transmembrane segment	K3
4.4	Subcellular Localization-Prediction Methods-PSORT, SUBLOC, TargetP and LOC3D.	Use various prediction methods to pinpoint the subcellular localization	K3
4.5	Functional Class-Prediction methods-EUCLID and ProtFun.	Apply EUCLID and ProtFun to foretell protein function	K4
5	**Protein structure prediction and analysis**		
5.1 & 5.2	Introduction- Protein structure databases-Other structure databases-MSD, MMDB, PDBSum, TargetDB.	Analyze the role of various structural databases like MMDB, Target DB	K4
		Inspect the protein structure using various visualization tools	
5.3	Visualizing Proteins	Create the 3D structure of a protein using various protein structure prediction methods	K5

Unit/ Secton	Course Contents	Learning Outcomes	HBTLT
5.4 5.5	Protein structure prediction & evaluation. Protein structure comparison.	Create the 3D structure of a protein using various protein structure prediction methods and compare the predicted structure.	

4. Mapping Scheme

I20BI	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	H	L	-	-	L	M	H	M	H	L
CO2	M	M	M	H	L	-	-	L	M	H	M	H	L
CO3	M	M	M	H	L	-	-	L	M	H	M	H	L
CO4	M	L	L	M	L	-	-	L	L	M	L	M	L
CO5	M	L	L	M	L	-	-	L	L	M	L	M	L
CO6	M	L	L	M	L	-	-	L	L	M	L	M	L

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

Core Prac IX : Programming in JAVA LAB

Semester : VII **Course Code: I23BI7P9**

Credits : 3 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Apply string handling in java	K3	1, 2
CO2	Experiment loops, conditions and operators	K4	3,4,5,6,7
CO3	Practice with arrays	K3	8,9
CO4	Construct applications with built-in functions	K5	10,11,12,13
CO5	Analyze sequences in applications	K4	14,15,16
CO6	Execute applications by dealing with memory addresses	K3	17,18

2. A. List of Experiments

Ex. No.	Exercise
1	Transcription to DNA to RNA sequence.
2	Calculate rotations per minute [rpm = 1000 √RCF / 11.17r]
3	Create amino acid dictionary using switch construct
4	Identify the glucose level in blood using if , else if construct [The glucose level is identified by <70 – hypoglycemia, 70-180 hyperglycemia, > 180 diabetics]
5	Identify the type of two peptides using nested if [peptide length is < 8 small, poly otherwise]
6	Count the number of base characters entered among n characters using loop
7	Implement stack operation
8	Count the number of positive, negative and zero energy molecules stored in an array
9	Find the transpose of the given matrix using two dimensional array
10	To calculate pH value for a given [OH-] concentration [pH = -log10(OH-)
11	Draw a line in different pattern using user defined function
12	Write a user defined function to illustrate the storage class of the variables

Ex. No.	Exercise
13	Count the number of gaps in the given sequence using user defined function
14	Sort n names
15	Align two sequences
16	Count the number of motif in the given sequence
17	Swap two numbers using pointers
18	Process the organism details using structure

B. Topics for Self Study:

S.No	Topics	Web links
1	Angular 2	https://www.youtube.com/watch?v=DBjPIabiRNg
2	React JS	https://reactjs.org/tutorial/tutorial.html
3	Docker and Kubernates	https://www.youtube.com/watch?v=bhBSlnQcq2k
4	AWS	https://aws.amazon.com/

C. Reference book(s)

1. Balagurusamy, E, Programming with Java, Tata McGraw Hill, Education Pvt Ltd, 5th Edition, 2015
2. Eckel Bruce, Thinking in Java for Java SE5/6, Pearson, 4th Edition, 2013.

D. Weblinks

1. https://www.w3resource.com/java-exercises/?passed=passed
2. https://code-exercises.com/
3. https://practity.com/765-2/
4. https://codingbat.com/java
5. https://techstudy.org/Java/Java-program-examples-with-output

3. Specific Learning Outcomes (SLO)

Ex. No.	Course Contents	Learning Outcomes	HBTLT
1	Transcription to DNA to RNA sequence.	Apply regular expressions	K3
2	Calculate rotations per minute [rpm = 1000 √RCF / 11.17r]	Use mathematical operations	K3
3	Create amino acid dictionary using switch construct	Perform condition checking	K3

Ex. No.	Course Contents	Learning Outcomes	HBTLT
4	Identify the glucose level in blood using if , else if construct [The glucose level is identified by <70 – hypoglycemia, 70-180 hyperglycemia, > 180 diabetics]	Differentiate different control structures	K4
5	Identify the type of two peptides using nested if [peptide length is < 8 small, poly otherwise]	Test multiple conditions	K4
6	Count the number of base characters entered among n characters using loop	Test loops in applications	K4
7	Implement stack operation	Apply stack data structure concept	K3
8	Count the number of positive, negative and zero energy molecules stored in an array	Illustrate arrays	K2
9	Find the transpose of the given matrix using two dimensional array	Employ matrix operations in real-time	K3
10	To calculate pH value for a given [OH-] concentration [pH = -log10(OH-)	Use mathematical operators in applications	K3
11	Draw a line in different pattern using user defined function	Design applications with user defined methods	K5
12	Write a user defined function to illustrate the storage class of the variables	Compose console applications with user defined methods	K5
13	Count the number of gaps in the given sequence using user defined function	Plan applications with java libraries	K5
14	Sort n names	Test different sorting methods	K4
15	Align two sequences	Perform aligning sequences	K3
16	Count the number of motif in the given sequence	Inspect the presence of motifs in sequences	K4
17	Swap two numbers using pointers	Illustrate pointers	K2
18	Process the organism details using structure	Use all the OOP concepts	K3

4. Mapping Scheme

I23BI7P9	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	L	-	M	H	H	L	H	L	L
CO2	L	L	L	M	-	-	-	H	H	M	H	L	L
CO3	M	M	M	H	M	H	-	H	H	M	H	H	M
CO4	L	M	H	L	L	M	M	H	H	H	H	H	M
CO5	L	H	M	M	L	L	M	H	H	H	H	H	H
CO6	M	M	M	M	H	H	H	H	H	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core Prac X : Bioinformatics Database And Tools Lab

Semester : VII **Course Code I23BIP10**
Credits : 3 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Use NCBI, EBI,DDBJ and UniProt for sequence analysis	K3	1
CO2	Analyze data retrieved from Genome Data Viewer using accessions numbers, gene names	K4	2
CO3	Demonstrate data retrieval from genome browser using Ensembl's	K3	3
CO4	Demonstrate various genome databases	K3	3
CO5	Use appropriate tools to predict the secondary structure of a protein sequence of interest	K3	5,6, 7
CO6	Appraise the quality of protein structure	K4	8

2. A. List of Experiments

1. Bioinformatics Database
   NCBI
   EBI
   DDBJ
   UniProt
2. Genome Data Viewer-Mapping Database
3. Genome Database
   Gene Cards
   Gene Loc
   euGenes
   Mouse Genome informatics Database
   Rat Genome Database
   UCSC Browser
   Ensembl
4. Predictive methods using protein Sequences
   Secondary structure prediction

Profacc https://open.predictprotein.org/

Jpred http://www.compbio.dundee.ac.uk/jpred/

5. Transmembrane segments-Prediction methods

TopPred http://single.topcons.net/

PHDhtm https://npsa-prabi.ibcp.fr/cgi-in/npsa_automat.pl?page=/NPSA/npsa_htm.html

SOSUI http://harrier.nagahama-i-bio.ac.jp/sosui/

TMHMM http://www.cbs.dtu.dk/services/TMHMM/

6. Predicting Function-Annotation

PROSITE https://prosite.expasy.org/

Pfam https://pfam.xfam.org/

InterPro https://www.ebi.ac.uk/interpro/

7. Subcellular Localization-Prediction Methods

PSORT https://psort.org/

TargetP http://www.cbs.dtu.dk/services/TargetP/

8. Protein structure prediction and analysis by modelling and evaluation and Visualisation

B. Topics for Self Study

S.No	Topics	Web links
1	Bioinformatics methods-1	https://www.coursera.org/learn/bioinformatics-methods-1
2	Genomic data science and clustering	https://www.coursera.org/learn/genomic-data
3	Bioinformatics method-2	https://www.coursera.org/lecture/bioinformatics-methods-2/

C. Reference Book(s)

1. Kalibulla Syed Ibrahim, et al., Bioinformatics—A Student' Companion, Springer, 2017
2. Jin Xiong, Essential Bioinformatics, Low Price Edition, Cambridge Press, 2019.
3. Teresa K. Attwood, David J. Parry-Smith. Introduction to bioinformatics, Pearson Education,1999.
4. Mount D. Bioinformatics : Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York.2004.

D. Weblink(s)

1. https://vlab.amrita.edu/index.php?sub=3&brch=275

3. Specific Learning Outcomes (SLO)

Ex. No	Lab Exercises	Learning Outcomes	HBTLT
1	Bioinformatics Database NCB EBI DDBJ UniProt	Practice retrieval of sequence from the given Database.	K3
2	Mapping Database	Analyze data retrieved from NCBI Mapping Database using accessions numbers, gene names	K4
3	Gene Cards Gene Loc euGenes	Demonstrate data retrieval from Gene cards and Gene Loc	K3
4	Mouse Genome informatics Database Rat Genome Database UCSC Browser Ensembl	Practice retrieval of sequence from the Mouse Genome Database.	K3
5	Secondary structure prediction Transmembrane segments-Prediction methods	Analyze the structure prediction methods Employ transmembrane tools to locate the transmembrane segment	K4 K3
6	Predicting Function-Annotation	Inspect the functional analysis of protein	K4
7	Subcellular Localization-Prediction Methods	Use various prediction methods to pinpoint the subcellular localization	K3
8	Protein structure prediction and analysis by 200odeling and evaluation and Visualisation	Analyze the 3D structure of a protein using various protein structure prediction method Inspect the protein structure using various visualization tools structure prediction methods	K4 K4

4. Mapping Scheme

I20BI	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	L	M	-	-	M	L	H	M	H	M
CO2	H	M	L	L	M	-	-	M	L	H	M	H	M
CO3	H	M	L	L	M	-	-	M	L	H	M	H	M
CO4	H	M	L	L	M	-	-	M	L	H	M	H	M
CO5	H	M	L	L	M	-	-	M	L	H	M	H	M
CO6	H	M	L	L	M	-	-	M	L	H	M	H	M

L : Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. M. Rajadurai

ELEC IV: PROTEIN: STRUCTURE AND FUNCTIONS

Semester : VII	**Course Code I23BI7:A**
CREDITS : 4	**Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	State the classifications of proteins based on their structure	K1	I
CO2	Discuss the interactions of the macromolecules	K2	II
CO3	Predict the protein structure using various tools	K3	III
CO4	Inspect the protein function prediction algorithms	K4	IV
CO5	Analyze the methodology of protein function prediction	K4	IV
CO6	Design novel strategy for predicting protein function	K5	V

2. A. Syllabus

Unit I –Introduction to Proteins **15 Hours**

1.1. Building blocks
1.2. Hierarchical representation of proteins: primary, secondary, tertiary and quaternary structure.
1.3. Structural classification of proteins
1.4. Structural databases

Unit II –Intra and Intermolecular Interactions **15 Hours**

2.1. Computation and representation of solvent accessibility
2.2. Residue – residue contacts
2.3. Contact potentials
2.4. Cation – π interactions
2.5. Free energy calculations
2.6. Protein parameters
2.7. Protein structure comparison.

Unit III –Protein Structure Prediction **15 Hours**

3.1. Introduction: protein identification and characterization
3.2. Structure analysis and prediction
3.3. Substructure: motifs, profiles, patterns and fingerprint search

3.4. Methods of structure prediction: sequence based, Ab Initio approach, 2D-Structure prediction.

Unit IV – Protein Dynamics: From structure to function 15 Hours

4.1. Principal component analysis
4.2. Collective Coordinate Sampling Algorithms – Essential Dynamics, TEE-REX
4.3. Methods for Functional Mode Prediction – Normal Mode Analysis, Elastic Network Models, CONCOORD
4.4. Integrated Servers for Structure-Informed Function Prediction: ProKnow&ProFunc

Unit V – Prediction of Protein Function from Theoretical Models 15 Hours

5.1. Background, Suitability of Protein 3D Models for Structure-Based Predictions
5.2. Surface Properties, Functional Sites, Specific Binding Predictions
5.3. Small Molecule Binding, Protein-Protein Interactions, Protein Model Databases
5.4. Function Prediction Examples – Plasticity of Catalytic Site Residues
5.5. Prediction of Ligand Specificity, Prediction of Cofactor Specificity Using an Entry from a Database of Models
5.6. Mutation Mapping, Protein Complexes, Structure Modelling of Alternatively Spliced Isoforms
5.7. From Broad Function to Molecular Details.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Protein Folding Mechanism	https://www.youtube.com/watch?v=z6OTR0oX3_E
2	Techniques to study Protein Protein Interactions	https://www.youtube.com/watch?v=Ia-5cQ9fhdo
3	CASP 2018	https://www.youtube.com/watch?v=jPg-4rkjZKc
4	Visualising Protein Dynamics	https://www.youtube.com/watch?v=fzM5V0bbybM
5	Function prediction by Neural networks	https://www.youtube.com/watch?v=x-35bDrKfHA&t=2s

C. Text Book(s)

1. MichealGromiha, M. Protein Bioinformatics: From sequence to function, Academic Press, 2011. (UNIT-I & II)
2. Rastogi,S.C. ParagRastogi, N. Mendiratta. Bioinformatics Methods and Applications: Genomics Proteomics And Drug Discovery, 4th Edition,

Prentice-Hall of India (Private), Limited, 2013. (UNIT-III)

3. Daniel John Rigden, From Protein Structure to Function with Bioinformatics. Springer, 2017 (UNIT-IV & V)

D. Reference Book(s)

1. Gregory A. Petsko, Dagmar Ringe, Protein Structure and Function , New Science Press, 2004.
2. David Whitford, Proteins: Structure and Function, Wiley, 2005.
3. Daniel John Rigden, From Protein Structure to Function with Bioinformatics. Springer, 2009.
4. EngelbertBuxbaum,Fundamentals of Protein Structure and Function, Springer, 2007.

E. Weblinks

1. https://www.youtube.com/watch?v=1XqVIRo9SQA
2. https://www.coursera.org/lecture/bioinformatics-methods-2/lecture-5ZHrb
3. https://www.coursera.org/lecture/bioinformatics-methods-2/lab-discussion-Vhtfk

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to Proteins**		
1.1 1.2	Building blocks Hierarchical representation of proteins: primary, secondary, tertiary and quaternary structure	Recall the structure, types and importance of proteins	K1
1.3	Structural classification of proteins	Classify the proteins based on structure	K2
1.4	Structural databases	List the structural databases of proteins	K1
2	**Intra and Intermolecular Interactions**		
2.1	Computation and representation of solvent accessibility	Discuss the location of solvent accessibility by computational approach	K2
2.2 2.3 2.4 2.5	Residue – residue contacts Contact potentials Cation – π interactions Free energy calculations	Describe the intra and inter molecular interactions Interpret the free energy calculations	K2 K2
2.6 2.7	Protein parameters Protein structure comparison.	Describe the protein parameters based on their interactions Compare the Protein structures	K2 K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3	**Protein Structure Prediction**		
3.1	Introduction: protein identification and characterization	List the various structures of proteins and methods of characterization	K1
3.2	Structure analysis and prediction	Employ tools to predict and analyze structure of proteins	K3
3.3	Substructure: motifs, profiles, patterns and fingerprint search	Demonstrate the various Substructure search	K3
3.4	Methods of structure prediction: sequence based, Ab Initio approach, 2D-Structure prediction	Differentiate the methods of structure prediction	K4
4	**Protein Dynamics: From structure to function**		
4.1	Principal component analysis	Explain the Principal component analysis (PCA)	K2
4.2	Collective Coordinate Sampling Algorithms – Essential Dynamics, TEE-REX	List the algorithms used for PCA	K1
4.3	Methods for Functional Mode Prediction – Normal Mode Analysis, Elastic Network Models, CONCOORD	Relate the methods used in Functional Mode Prediction	K4
4.4	Integrated Servers for Structure-Informed Function Prediction: ProKnow&ProFunc	Inspect the servers involved in structure based function prediction	K4
5	**Prediction of Protein Function from Theoretical Models**		
5.1	Background, Suitability of Protein 3D Models for Structure-Based Predictions	Recall the fundamentals of Structure-Based Predictions	K1
5.2	Surface Properties, Functional Sites, Specific Binding Predictions	Summarize the principles of surface properties	K2
5.3	Small Molecule Binding, Protein-Protein Interactions, Protein Model Databases	Compare the bio molecular interactions	K2
5.4	Function Prediction Examples – Plasticity of Catalytic Site Residues	Calculate the plasticity of catalytic site residues	K4
5.5	Prediction of Ligand Specificity, Prediction of Cofactor Specificity Using an Entryfrom a Database of Models	Assess the specificity of models through computational approach	K6
5.6 & 5.7	Mutation Mapping, Protein Complexes, Structure Modelling of Alternatively Spliced Isoforms From Broad Function to Molecular Details	Create a new model for Alternatively Spliced Isoforms using the taught information	K5

4. Mapping Scheme

I23BI7:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	L	L	-	L	M	L	H	M	M	H
CO2	M	M	M	L	L	-	L	M	L	H	M	M	H
CO3	M	M	M	L	L	-	L	M	L	H	M	M	H
CO4	H	L	M	M	L	-	L	M	L	H	M	M	M
CO5	H	L	M	M	L	-	L	M	L	H	M	M	M
CO6	H	L	M	M	L	-	L	M	L	H	M	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Jebastin

Elec IV : Molecular Interactions

Semester : VII **Course Code I23BI7:B**
Credits : 4 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the fundamentals of atomic and molecular orbitals	K2	I
CO2	Classify the different types of bonded and non-bonded interactions	K2	II
CO3	Discuss the principles of protein folding and secondary structures	K2	III
CO4	Summarize the various molecular interactions in macromolecules	K2	IV
CO5	Analyze the principles of molecular interactions	K2	IV
CO6	Critique the principles and applications of spectroscopy in predicting the macromolecules structure	K4	V

2. A. Syllabus

Unit I Fundamentals of atomic and molecular orbitals

1.1. Theory of atomic and molecular orbitals; Linear combination of atomic orbitals
1.2. Quantitative treatment of valency bond theory and molecular orbital theory
1.3. Resonance structures; -bonds and -bonds

Unit II - Fundamentalsof chemical bonding and non-bonding interactions

2.1. Electrovalent bond, stability of electrovalent bond
2.2. Covalent bond – partial ionic character of covalent bonds
2.3. Shape of orbitals and hybridization
2.4. Co-ordination bond, Vander Waals forces; Metallic bond.
2.5. Molecular geometry- VSEPR Theory.

Unit III - Folding pathways

3.1. Principles of protein folding, role of chaperons
3.2. Hydrophobic interactions, electrostatic interactions, non-bonded interactions.
3.3. Beta turns, gamma turns, types of helices, Disulphide Bridge.

Unit IV - Molecular interactions

4.1. Protein-protein, protein-DNA, DNA-Drug, Protein-Lipid, Protein-Ligand, Protein-Carbohydrate interaction
4.2. Metalloprotein.
4.3. Pi … Pi interactions, C-H…Pi interactions.

Unit V - Spectroscopy

5.1. Principle, Theory, Instrumentation and Application of UV, IR, NMR and Circular dichroism (CD) to macro molecules.
5.2. Stereochemistry of proteins and nucleic acids.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Hybridization of Atomic Orbitals	https://www.youtube.com/watch?v=otYj92d7rB0
2	Applications of VSEPR Theory	https://www.youtube.com/watch?v=9P3wQo6NMK4
3	Types of Bonds	https://www.youtube.com/watch?v=y_JJSgIDzt0
4	Protein-Protein Interactions	csb.pitt.edu/ComputationalGenomics/Lectures/Lec26.pdf
5	Small Molecule Spectroscopy and Dynamics	https://www.youtube.com/watch?v=LQRPRIsCQkI

C. Text Book(s)

1. VasanthaPattabhi, N. Gautham, Biophysics, Narosa publishing house, 2002.

D. Reference Book(s)

1. Albert cotton, F. Chemical Application of Group Theory. John Wiley and Sons, Inc. New York, 1971.
2. Spice, J. E. Chemical Bonding and Structure. Pergamon Press Ltd., Headington Hill Hall, Oxford, 1964
3. Winter, M.J.Chemical Bonding. Oxford University Press, Inc., New York, 1996.
4. Ernest Eliel. Stereochemistry of carbon compounds, Prentice Hall, 1996.
5. Shanmughavel, P. Principles of Bioinformatics, Pointer Publishers, Jaipur, India, 2005.

E. Weblinks

1. https://nptel.ac.in/courses/102/101/102101054/
2. https://nptel.ac.in/courses/104/106/104106075/
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-cy23/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Fundamentals of atomic and molecular orbitals**		
1.1	Theory of atomic and molecular orbitals; Linear combination of atomic orbitals	Define atomic orbitals	K1
1.2	Quantitative treatment of valency bond theory and molecular orbital theory	Explain the molecular orbital theories	K2
1.3	Resonance structures; -bonds and –bonds	Recall the resonance of bonds	K1
2	**Fundamentals of chemical bonding and non-bonding interactions**		
2.1	Electrovalent bond, stability of electrovalent bond	Describe the stability of electrovalent bond	K2
2.2	Covalent bond – partial ionic character of covalent bonds	Explain the characteristics of covalent bond	K2
2.3	Shape of orbitals and hybridization	Discuss the shapes of orbitals	K2
2.4	Co-ordination bond, Vander Waals forces; Metallic bond.	List out the types of interactions	K1
2.5	Molecular geometry- VSEPR Theory.		
3	**Folding pathways**		
3.1	Principles of protein folding, role of chaperons	Recall the Principles of protein folding	K1
3.2	Hydrophobic interactions, electrostatic interactions, non-bonded interactions	Summarize the various non bonded interactions	K2
3.3	Beta turns, gamma turns, types of helices, Disulphide Bridge	Explain the types of secondary structure of proteins	K2
4	**Molecular interactions**		
4.1	Protein-protein, protein-DNA, DNA-Drug, Protein-Lipid, Protein-Ligand, Protein-Carbohydrate interaction	Explain the types of interactions in biomolecules	K2
4.2	Metalloprotein	Define Metalloprotein	K1
4.3	Pi … Pi interactions, C-H…Pi interactions	Explain the Pi…pi interactions in biomolecules	K2
5	**Spectroscopy**		
5.1	Principle, Theory, Instrumentation and Application of UV, IR, NMR and Circular dichroism (CD) to macro molecules	Summarize the fundamentals of spectroscopy	K2
5.2	Stereochemistry of proteins and nucleic acids	Analyze the Stereochemistry of proteins and nucleic acids	K4

4. Mapping Scheme

I23BI7:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	L	L	M	-	L	L	L	M	L	L	L
CO2	M	L	L	L	M	-	L	L	L	M	L	L	L
CO3	M	L	L	L	M	-	L	L	L	M	L	L	L
CO4	M	L	L	L	M	-	L	L	L	M	L	L	L
CO5	M	L	L	L	M	-	L	L	L	M	L	L	L
CO6	M	M	M	M	M	L	L	M	L	H	M	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Core XII : R Programming for Bioinformatics

Semester : VIII **Course Code : I23BI812**

Credits : 5 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Summarize the features R packages in Bioinformatics	K2	I
CO2	Describe the operations involved in R packages	K2	II
CO3	Use file handling operations to retrieve biological data	K3	III
CO4	Inspect the wide array of Built-in functions available in R packages	K4	IV
CO5	Employ various R functions to align biological sequences	K3	IV
CO6	Develop programs to carry out exception handling in R	K5	V

2. A. Syllabus

Unit I - R Packages and Technologies **15 Hours**

1.1 Introduction to R-Installing R packages in windows and linux OS-Bioconductor R package-Running R. Package basics- The search path- Package information-Data and demos-Package management-Package authoring.

1.2 Database technologies-Using R for data manipulationDBI-SQLite

1.3 Using R for Bioinformatics-R packages for bioinformatics: Bioconductor and SeqinR-Retrieving genome sequence data using SeqinR-Reading and writing sequence data into R

1.4 Bioinformatics resources on the WWW -PubMed-NCBI-biomaRt-Getting data from GEO-KEGG

Unit II - Introduction to R Programming **15 Hours**

2.1 A brief introduction to R - Attributes -A very brief introduction to OOP in R - Some special values-Types of objects-Sequence generating and vector subsetting -Types of functions.

2.2 Data structures - Atomic vectors -Numerical computing Factors Lists, environments and data frames

2.3 Language basics-Operators - Subscripting and subsetting-Vector and matrix subsetting - Vectorized - The recycling rule -Replacement functions

2.4 Functional programming -Writing Flow control -Conditionals Exception handling -Evaluation –Basics of Object-Oriented Programming in R(Classes and methods)

Unit III - Input and Output in R **15 Hours**

3.1 Basic file handling-Viewing files- File manipulation-File manipulation-Working with R's binary format

3.2 Connections-Text connections- Interprocess communications-Seek

3.3 File input and output-Reading rectangular data-Writing data-Debian Control Format (DCF)-FASTA Form

Unit IV - Working with Character Data **15 Hours**

4.1 Builtin capabilities-Modifying text-Sorting and comparing-Matching a set of alternatives-Formatting text and numbers-Special characters and escaping-Parsing and deparsing-Plotting with text

4.2 Regular expressions-Matching-Using regular expressions-Globbing and regular expressions-Prefixes, suffixes and substrings- Matching patterns-Biological sequences-Encoding genomes-Alignments

4.3 Foreign Language Interfaces-Writing C code to interface with R-Calling R from C-Using the R API- Evaluating R expressions from C

Unit V - Debugging and Profiling **15 Hours**

5.1 Debugging in R-Runtime debugging-Warnings and other exceptions-Interactive debugging-The debug and undebug functions-The trace function-Debugging C and other foreign code-Profiling R code.

5.2 Managing memory-Memory profiling -Profiling memory allocation -Tracking a single object

B. Topics for Self Study:

S.No	Topics	Web Link
1	Computational Genomics with R	http://evomics.org/learning/programming/introduction-to-r/
2	Exploratory analysis of Biological Data	https://www.youtube.com/watch?v=MCJD5iJjr7Y
3	Introduction to R for Biologists	https://bioinfotraining.bio.cam.ac.uk/postgraduate/programming/bioinfo-introRbio
4	R/Bioconductor	https://www.youtube.com/watch?v=WFA37FPLHqg

C. Text Book(s)

1. Robert Gentleman,R Programming for Bioinformatics,Chapman& Hall/CRC Taylor & Francis Group press(2008) (Units II To V)
2. AvrilCoghlan,A Little Book of R For Bioinformatics,2017,: https://github.com/avrilcoghlan/LittleBookofRBioinformatics/raw/master/_build/latex/Bioinformatics.pdf. (Unit I)

D. Reference Book(s)

1. Mark Gardener, Beginning R -The Statistical Programming Language, Wiley Publications, 2015
2. Larry Pace, Beginning R – An Introduction to Statistical Programming, Apress (www.it-ebooks.info)
3. W. John Braun and Duncan J. Murdoch, A First Course in Statistical Programming with R, Cambridge University Press, 2007.
4. R Programming for Bioinformatics (Chapman & Hall/CRC Computer Science & Data Analysis) - Robert Gentleman; 2008

E. Weblinks

1. https://onlinecourses.nptel.ac.in/noc20_ma53/preview
2. https://www.coursera.org/lecture/data-genes-medicine/r-language-yTtOJ

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**R Packages and Technologies**		
1.1	Introduction to R-Installing R packages in windows and linux OS- Bioconductor R package-Running R. Package basics- The search path-Package information-Data and demos-Package management-Package authoring.	State the basic concepts in installing R packages	K1
1.2	Database technologies-Using R for data manipulationDBI-SQLite	Discuss the uses of data manipulation techniques in R	K2
1.3	Using R for Bioinformatics-R packages for bioinformatics: Bioconductor and SeqinR-Retrieving genome sequence data using SeqinR-Reading and writing sequence data into R	Practice the retrieval of biological sequences using R packages	K3
1.4	Bioinformatics resources on the WWW -PubMed-NCBI-biomaRt-Getting data from GEO-KEGG	Report the available online Bioinformatics resources	K2
2	**Introduction to R Programming**		
2.1	A brief introduction to R - Attributes -A very brief introduction to OOP in R - Some special values-Types of objects-Sequence generating and vector subsetting -Types of functions.	Tell the attributes of R	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2.2	Data structures - Atomic vectors -Numerical computing Factors Lists, environments and data frames	Discuss the role of data structures	K2
2.3	Language basics-Operators - Subscripting and subsetting-Vector and matrix subsetting - Vectorized - The recycling rule -Replacement functions	Explain the subsetting functions in language	K2
3	**Input and Output in R**		
3.1	Basic file handling-Viewing files- File manipulation- File manipulation-Working with R's binary format	Use file handling operations to retrieve biological data	K3
3.2	Connections-Text connections- Interprocess communications-Seek	Employ text connections while handling biological data	K3
3.3	File input and output-Reading rectangular data-Writing data-Debian Control Format (DCF)-FASTA Form	Demonstrate the Debian Control Format (DCF)	K3
4	**Working with Character Data**		
4.1	Builtin capabilities-Modifying text-Sorting and comparing-Matching a set of alternatives-Formatting text and numbers-Special characters and escaping-Parsing and deparsing-Plotting with text	Inspect the wide array of Built-in functions available in R packages	K4
4.2	Regular expressions-Matching-Using regular expressions-Globbing and regular expressions-Prefixes, suffixes and substrings- Matching patterns-Biological sequences-Encoding genomes-Alignments	Employ various R functions to align biological sequences	K3
4.3	Foreign Language Interfaces-Writing C code to interface with R-Calling R from C-Using the R API-Evaluating R expressions from C	Practice the skill of writing C code with R interface	K3
5	**Debugging and Profiling**		
5.1	Debugging in R-Runtime debugging-Warnings and other exceptions-Interactive debugging-The debug and undebug functions-The trace function-Debugging C and other foreign code-Profiling R code.	Develop programs to carry out exception handling in R	K5
5.2	Managing memory-Memory profiling -Profiling memory allocation -Tracking a single object	Describe tracking a single object by memory profiling	K2

4. Mapping Scheme

I23BI812	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H	M	L	M	L	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	H
CO3	H	H	H	H	H	M	L	M	L	H	H	M	H
CO4	H	H	L	L	L	L	L	-	-	H	H	L	H
CO5	H	H	L	L	L	L	L	-	-	H	H	L	H
CO6	L	H	M	M	M	L	M	H	-	L	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Arputhamary

Core XIII : Probability and Biomathematics

Semester : VIII **Course Code : I23BI813**

Credits : 5 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Apply the concept of Chi Square Test in Biological problems	K3	I
CO2	Identify the relationship between Binomial, Poisson, Normal distribution by Studying their properties	K3	II
CO3	Apply the concepts Inference and hypothesis testing in sampling distribution	K3	III
CO4	Analyze biological problems with statistical data	K4	IV
CO5	Formulate the applications of differentiation in Biological problems.	K5	V
CO6	Build the concepts of various differential calculus theorems in Bio programming	K5	V

2. A. Syllabus

Unit I- Chi-Square Test **15 Hours**

1.1. **Probability :** Types of Probability – Rules of Probability

1.2. Applications of Principles of Probability to Biological Problems.

1.3. **Chi-Square Test:**Assumptions and Conditions for the use of χ^2 Test – Procedure for χ^2 Test – Applications of Chi Square Test.

Unit II - Distributions **15 Hours**

2.1. **Discrete Distribution:** Binomial Distribution: Properties of Binomial Distribution – Fitting Binomial Distribution and Testing its Goodness-of-fit.PoissonDistribution:Properties of Poisson Distribution – Applications of Poisson Distribution.

2.2. **Continuous Distribution:** Normal Distribution: Properties of Normal Curve – Computation of Normal Probability – Fitting Normal Curve for the Data.

Unit III- Student's t-Distribution **15 Hours**

3.1. **Inference about Population:** Sampling Distribution – Use of Standard Error in the Inference.

3.2. **Hypothesis Testing:** Hypothesis and Null Hypothesis – Level of Significance – Decision about H_0.

3.3. **Student's *t*-Test:** Student's *t*-Distribution – Applications of *t*-Distribution.

3.4. **Analysis of Variance (ANOVA):** Principle of ANOVA – Partitioning of the Variance.

Unit IV- Differential Calculus Applications I **15 Hours**

4.1. **Differential Calculus – Applications I :** Meaning of the derivative: Geometrical Interpretation - Meaning of the sign of the differential coefficient –

4.2. Rate of change of variables – Velocity and Acceleration (Example problems only) – Maxima and Minima –

4.3. Concavity and Convexity, Points of Inflexion.

Unit V- Differential Calculus – Applications II **15 Hours**

5.1. **Differential Calculus – Applications II :** The direction of the tangent – Equations of the tangent and normal at any point of a curve – Properties of the tangents and normals –

5.2. Angle of intersection of curves - Rolle's Theorem – Mean Value Theorem

5.3. Expansions of Functions – Taylor's Theorem – Cauchy's form of Remainder – Taylor's and Maclaurin's series

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Applications of Probability Theory	http://www2.siit.tu.ac.th/prapun/IES302/IES302%20-%202%20-%20Sets%20Classical%20Combinatorics.pdf
2	Advanced Calculus	http://people.math.harvard.edu/~shlomo/docs/Advanced_Calculus.pdf/
3	Functional DNA-Applications of Taylor's series	https://www.tandfonline.com/doi/full/10.1080/10511970903261910?scroll=top&needAccess=true

C. Text Book(s)

1. Gurumani, N., "An Introduction to Biostatistics", MJP Publisher, 2nd Edition, 2015. (Units-I,II,III)

Unit I : Chapter – 13,15
Unit II : Chapters – 16, 17, 18
Unit III : Chapters– 19, 21, 22
Chapter – 23; Sections – 23.2, 23.3

2. Narayanan and T K ManicavachagomPillay, "Calculus-Volume I", S. Viswanathan (Printers & Publishers) Pvt., Ltd, Reprint 2011.(Units IV & V)

Unit IV - : Chapter-4; Sections – 1-4.
Chapter-5; Sections- 1.1-1.4 & 2.

Unit V : Chapter-9; Sections-1.1-1.4
Chapter-6; Sections- 1-2.1
Chapter-7; Sections-1.1-1.4

D. Reference Book(s)

1. Zar, J. H., "Biostatistical Analysis", Pearson Education (Singapore) Pvt. Ltd., 4th Edition, 1999.
2. Erwin Kreysig, "Engineering Mathematics", 7th Edition, John Wiley, USA, 2001.
3. Sundar Rao, An Introduction to Biostatistics, Prentics – Hall of India, 3rd Edition, 2004.
4. P. Mariyappan, Biostatics: An Introduction, Pearson, Chennai, 2013.

E. Weblinks

1. https://nptel.ac.in/courses/111/105/111105041/
2. https://nptel.ac.in/courses/111/102/111102111/
3. https://nptel.ac.in/courses/111/105/111105090/

3. Specific Learning Outcomes (SLO)

Unit/ Section[i]	Course Content	Learning Outcomes	HBTLT
1	**Chi-Square Test**		
1.1	Probability: Types of probability	Define probability and types of probability with different examples	K1
1.2	Rules of probability	Define rules of probability	K1
1.3	Applications of Principles of Probability to Biological problems	Solve biological problems using principles of probability	K3
1.4	Assumptions and Conditions for the use of χ^2 Test	Explain χ^2 Test and conditions for χ^2 Test	K2
1.5	Procedure for χ^2 Test	Explain why we need χ^2 Test	K5
1.6	Applications of Chi Square test	Solve biological problems using χ^2 Test	K6
2	**Distributions**		
2.1	Discrete distribution: Binomial distribution: Properties of Binomial distribution	Define Binomial distribution and its properties	K1
	Fitting of Binomial distribution and testing its Goodness-of-fit.	Solve biological problems using binomial distribution and testing good-of-fit	K3

Unit/ Section[ii]	Course Content	Learning Outcomes	HBTLT
2.2	Poisson Distribution : Properties of Poisson distribution	Define poisson distribution and its properties	K1
	Applications of Poisson distribution	Solve biological problems using poisson distribution	K3
2.3	Continuous distribution: Normal distribution : Properties of Normal curve	Define Normal distribution and its properties	K1
2.4	Computation of normal probability	Solve biological problems using Normal distribution	K6
2.5	fitting Normal Curve for the Data	Evaluate given data by fitting normal curve	K5
3	**Student's t-Distribution**		
3.1	Inference about population: Sampling distribution	Explain sampling distribution and standard error	K2
	Use of Standard Error in the inference.	Explain use of standard error in the inference	K2
3.2	Hypothesis testing : Hypothesis and Null Hypothesis	Explain Hypothesis and Null hypothesis and level of significance	K2
3.3	level of significance	Explain level of significance	K2
3.4	Decision about H_0	Explain how to make decision about H_0	K2
3.5	Student's t-Test: Student's t-Distribution	Explain Student's t-test	K2
3.6	Applications of t-Distributions	Solve biological problems using t-test	K6
3.7	Analysis of Variance (ANOVA): Principle of ANOVA-	Explain ANOVA	K2
3.8	Partitioning of the Variance	Explain partitioning of variance	K2
4	**Differential Calculus Applications I**		
4.1	Differential Calculus- Application I : Meaning of the derivative: Geometrical Interpretation	Define meaning of sign of differential coefficient in a mathematical way	K1
4.2	Meaning of the sign of the differential coefficient-	Explain velocity, acceleration in a geometrical way	K2
4.3	Rate of change of variables	Solve real life problems using differential calculus	K3
4.4	Velocity and Acceleration	Define Velocity and Acceleration	K1
4.5	Maxima and Minima	Define maxima and minima, concavity and convexity, points of reflexion	K1
4.6	Concavity and Convexity	Solve real life problems using maxima and minima, concavity and convexity	K6
4.7	Points of Inflexion	Explain points of reflexion	K2
5	**Differential Calculus – Applications II**		
5.1	Differential Calculus- Application II:The derivation of the tangent	Define equation of the tangent and normal at any point of a curve	K1

Unit/ Section[iii]	Course Content	Learning Outcomes	HBTLT
5.2	Equations of the tangent and normal at any point of a curve	Explain properties of the tangents and normal's	K2
5.3	Properties of the tangents and normals	Explain angle of intersection of curves	K2
5.4	Angle of intersection of curves	Solve different biological problems	K3
5.5	Rolle's theorem	Outline Rolle's theorem	K2
5.6	Mean value theorem	Outline Mean value theorem	K2
5.7	Expansions of Functions	Solve problems using Taylor's and Maclaurin's series	k6
5.8	Taylor's theorem	Outline Taylor's theorem	K2
5.9	Cauchy's form of Remainder	Outline Cauchy's form of Remainder	K2
5.10	Taylor's and Maclaurin's series	Explain Taylor's series and Maclaurin's series	K2

4. Mapping Scheme

I23BI813	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Rameeza

Core XIV : Principles of Drug Design and Development

Semester : VIII **Course Code : I23BI814**

Credits : 5 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Explain the concepts of drug action and discovery	K2	I
CO2	Demonstrate the steps such as lead discovery, modification and optimization	K3	II
CO3	Relate the quantitative structure with activity for lead discovery	K4	II
CO4	Revise the interaction of drug with receptors	K5	III
CO5	Assess the factors affecting the interaction of lead and target	K6	IV
CO6	Analyze the stereochemistry of drug metabolism	K5	V

2. A. Syllabus

Unit I - Introduction to drugs, their action and discovery and Development **15 Hours**

1.1 Drugs Discovered without Rational Design- Medicinal Chemistry Folklore -stages in modern-day drug discovery and design -Discovery of Drugs through Metabolism Studies -Discovery of Drugs through Clinical Observations.

1.2 Modern Rational Drug Design -Overview of Drug Targets -Identification and Validation of targets for Drug Discovery -Alternatives to Target-Based Drug Discovery .

1.3 Lead Discovery-Lead Modification (Lead Optimization)-Potency, Selectivity, Absorption, Distribution, Metabolism, and Excretion (ADME) Intellectual Property Position

1.4 Drug Development, Preclinical Development ,Clinical Development (Human Clinical Trials),Regulatory Approval to Market the Drug.

Unit II - Lead Discovery and Lead Modification **15 Hours**

2.1 Lead Discovery- Sources of Lead Compounds- Endogenous Ligands -Other Known Ligands -Screening of Compounds-Natural Products, High-Throughput Organic Synthesis, Evolution of HTOS, Targeted (or Focused) Screening, Virtual Screening, and Computational Methods in Lead Discovery, Hit-To-Lead Process -Fragment-based Lead Discovery

2.2 Lead Modification- Identification of the Active Part- The Pharmacophore - Functional Group Modification -Structure–Activity Relationships - Structure Modifications to Increase Potency, Therapeutic Index, and ADME Properties

2.3 Computational Methods in Lead Modification- Quantitative Structure–Activity Relationships (QSARs), Computational Methods for ADME Descriptors, Molecular Graphics-Based Lead Modification.

Unit III - Receptors and Enzyme inhibition in Drug Discovery 15 Hours

3.1 Drug–Receptor Interactions -Important Interactions (Forces) Involved in the Drug–Receptor Complex-Determination of Drug–Receptor Interactions-Theories for Drug–Receptor Interactions.

3.2 Enzymes as Catalysts-Specificity of Enzyme-Catalyzed Reactions- Binding Specificity ,Reaction, Rate Acceleration-

3.3 Enzyme Catalysis in Drug Discovery-Enzymatic Synthesis of Chiral Drug Intermediates, Enzyme Therapy

3.4 Reversible Enzyme Inhibitors- Simple Competitive Inhibition- Irreversible Enzyme Inhibitors- Case History of Rational Drug Design of an Enzyme Inhibitor: Ritonavir

Unit IV - Drug action mechanism 15 Hours

4.1 Drug Resistance- Mechanisms of Drug Resistance-Altered Target Enzyme or Receptor, Overproduction of the Target Enzyme or Receptor, Overproduction of the Substrate or Ligand for the Target Protein.

4.2 Increased Drug-Destroying Mechanisms, Decreased- Prodrug Activating Mechanism Activation of New Pathways -Reversal of Drug Action-Altered Drug Distribution to the Site of Action.

4.3 Synergistic effect of drugs and its mechanisms - Inhibition of a Drug-Destroying Enzyme-Sequential Blocking-Inhibition of Targets in Different Pathways - Use of Multiple Drugs for the Same Target

Unit V - Drug Metabolism and Drug development 15 Hours

5.1 The stereochemistry of drug metabolism- Secondary pharmacological implications of metabolism Sites of action

5.2 Phase I metabolic reactions- Phase II metabolic routes - Pharmacokinetics of metabolites - Drug metabolism and drug design - Prodrugs

5.3 Drug development and production- Chemical development- Pharmacological and toxicological testing- Drug metabolism and pharmacokinetics-Production and quality control- Patent protection- Regulation

B. Topics for Self Study:

S.No	Topics	Web Links
1.	Drug and databases	https://nptel.ac.in/courses/102/106/102106070/
2.	3D QSAR	https://www.youtube.com/watch?v=-Kq_EZMzKy4
3.	Drug Discovery and Development Using AI	https://www.youtube.com/watch?v=xhb7tBbSF0g
4.	Clinical Research and data management	http://hub.ucsf.edu/clinical-study-management

C. Text Book(s)

1. Richard B. Silverman, Mark W. Holladay, The Organic Chemistry of Drug Design and Drug Action- Third Edition, Elsevier Publications.
2. Medicinal Chemistry An Introduction (second edition)-Gareth Thomas, Wiley Publications.2007

D. Reference Book(s)

1. Computational Chemistry and Molecular Modeling - K. I. Ramachandran, GopakumarDeepa, Krishnan Namboori Publisher: Springer – Verlag Berlin Heidelberg. 2008.
2. An Introduction to Medicinal Chemistry, graham l. Patrick- Oxford New York Tokyo Oxford University Press 1995.

E. Weblinks

1. https://nptel.ac.in/courses/104/105/104105120/
2. https://nptel.ac.in/courses/102/108/102108077/
3. https://nptel.ac.in/courses/102/106/102106070/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	Introduction to drugs, their action and discovery and Development		
1.1	Drugs Discovered without Rational Design- Medicinal Chemistry Folklore - stages in modern-day drug discovery and design -Discovery of Drugs through Metabolism Studies -Discovery of Drugs through Clinical Observations.	Describe the steps involved in drug discovery	K2

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1.2	Modern Rational Drug Design -Overview of Drug Targets -Identification and Validation of targets for Drug Discovery -Alternatives to Target-Based Drug Discovery	Locate an effective target for a drug	K2
1.3	Lead Discovery-Lead Modification (Lead Optimization)-Potency ,Selectivity,Absorption, Distribution, Metabolism, and Excretion (ADME) Intellectual Property Position	Identify a potential lead compound	K2
1.4	Drug Development , Preclinical Development ,Clinical Development (Human Clinical Trials) ,Regulatory Approval to Market the Drug.	Summarize the Preclinical trials of drug development	K2
2	**Lead Discovery and Lead Modification**		
2.1	Lead Discovery- Sources of Lead Compounds-Endogenous Ligands -Other Known Ligands -Screening of Compounds-Natural Products, High-Throughput Organic Synthesis, Evolution of HTOS, Targeted (or Focused) Screening, Virtual Screening, and Computational Methods in Lead Discovery, Hit-To-Lead Process -Fragment-based Lead Discovery	List the sources of lead compounds Demonstrate the computational methods in lead discovery	K1 K3
2.2	Lead Modification- Identification of the Active Part- The Pharmacophore -Functional Group Modification -Structure–Activity Relationships -Structure Modifications to Increase Potency, Therapeutic Index, and ADME Properties	Discuss the methods of improvising the efficacy of lead compounds	K2
2.3	Computational Methods in Lead Modification-Quantitative Structure–Activity Relationships (QSARs), Computational Methods for ADME Descriptors, Molecular Graphics-Based Lead Modification.	Relate the property with activity of a lead using computational methods	K4
3	**Receptors and Enzyme inhibition in Drug Discovery**		
3.1	Drug–Receptor Interactions -Important Interactions (Forces) Involved in the Drug–Receptor Complex-Determination of Drug–Receptor Interactions- Theories for Drug–Receptor Interactions.	Revise the basic concepts of Drug receptor interaction	K5
3.2	Enzymes as Catalysts-Specificity of Enzyme-Catalyzed Reactions- Binding Specificity ,Reaction, Rate Acceleration-	Analyze the enzyme- substrate complex reactions	K4
3.3	Enzyme Catalysis in Drug Discovery-Enzymatic Synthesis of Chiral Drug Intermediates, Enzyme Therapy	Theorize the importance of enzyme therapy	K4

Unit/ Section	Course Content	Learning Outcomes	HBTLT
3.4	Reversible Enzyme Inhibitors- Simple Competitive Inhibition- Irreversible Enzyme Inhibitors- Case History of Rational Drug Design of an Enzyme Inhibitor: Ritonavir	Describe the mechanism of reversible, irreversible and competitive enzyme inhibition Analyze the role of Ritonavir as an enzyme inhibitor	K2 K4
4	**Drug action mechanism**		
4.1	Drug Resistance- Mechanisms of Drug Resistance-Altered Target Enzyme or Receptor, Overproduction of the Target Enzyme or Receptor, Overproduction of the Substrate or Ligand for the Target Protein.	Demonstrate the principles of drug resistance mechanism	K3
4.2	Increased Drug-Destroying Mechanisms, Decreased- Prodrug Activating Mechanism Activation of New Pathways -Reversal of Drug Action-Altered Drug Distribution to the Site of Action.	Discuss the prodrug activating mechanism and relate to reversal of drug action	K2,K4
4.3	Synergistic effect of drugs and its mechanisms - Inhibition of a Drug-Destroying Enzyme- Sequential Blocking-Inhibition of Targets in Different Pathways - Use of Multiple Drugs for the Same Target	Analyze the synergistic effect of drugs on the same targets	K4
5	**Drug Metabolism and Drug development**		
5.1	The stereochemistry of drug metabolism-Secondary pharmacological implications of metabolism Sites of action	Analyze the stereochemistry of drug metabolism	K4
5.2	Phase I metabolic reactions- Phase II metabolic routes - Pharmacokinetics of metabolites - Drug metabolism and drug design – Prodrugs	Report on the biotransformation of a drug molecule before acting on the target	K6
5.3	Drug development and production- Chemical development- Pharmacological and toxicological testing- Drug metabolism and pharmacokinetics-Production and quality control- Patent protection-Regulation	Build the steps involved in post clinical trials and regulation	K5

4. Mapping Scheme

I23BI814	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	M	L	L	L	L	M	M	H	M	H
CO2	H	H	M	M	L	M	L	M	M	H	H	H	M
CO3	H	M	M	M	M	M	L	L	M	H	M	H	M
CO4	H	M	L	M	L	H	L	M	M	H	H	M	M
CO5	H	M	M	M	L	M	L	M	M	H	H	M	M
CO6	H	L	L	M	L	M	L	M	M	M	M	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. Sherlin Rosita

Core Prac XI : Computational Biology, Biostatisticsusing R and Drug Designing Lab

Semester : VIII **Course code : I23BIP11**

Credits : 3 **Hours 5**

1. Course Outcomes

After completion of this course, the students will be able to

S.No	Course Outcomes	BTLT	Ex. Covered
CO1	Design the small molecules and prepare them in proper file format	K5	I
CO2	Perform molecular docking using advance docking tools and interpret the post-docking results	K3	II
CO3	Analyze the patterns of the given through specialized sequence alignment	K4	III
CO4	Compare the given protein sequences using R programming	K6	IV
CO5	Quantify the different distributions for the given sequences	K4	IV
CO6	Develop shell scripts to retrieve the protein sequences	K5	V

2. A. List of Experiments

1. Pair wise alignment:

a. Position-Specific Iterated (PSI)-BLAST

b. Pattern-Hit Initiated (PHI)-BLAST

c. Domain Enhanced Lookup Time Accelerated-BLAST (DELTA-BLAST)

2. Multiple sequence alignment:

a. Small Sequences – T-Coffee

b. Medium Sequences - MUSCLE

c. Large Sequences - MAFFT

3. Sequence patterns and profiles:

a. SCanProsite

b. PRATT

4. Protein motif and domain analysis:

a. MEME/MAST
b. eMotif
c. InterproScan
d. ProSite
e. ProDom
f. Pfam

5. Phylogenetic analysis – MEGA, PAUP, PHYLIP

6. Drawing chemical structure using ChemSketch.

7. Conversion of 2D to 3D: Open Babel

8. Molecular Docking: AUTODOCK TOOLS

9. Post Docking Analysis: LIGPLOT. PoseView,

Compute the Following Concepts in Biostatics Using R Programming

a. Calculation of measures of central tendency
b. Calculation of measures of dispersion
c. Graphical display of data
d. Analysing data using tables
e. Binomial distribution
f. Normal distribution
g. Poisson distribution
h. One sample t-test
i. One-way between groups ANOVA
j. Bivariate correlation
k. Rank correlation
l. Regression

1. Write a shell script program to search and retrieve sequences
2. Write an R script to find the name of the input sequences using GREP command
3. Write an R script to analyze and visualize the graph for protein interaction data
4. Write an R script to build a phylogenetic tree for protein sequences.
5. Write an R script to compare two protein sequences using dotplot.

B. Topics for self study

S.No	Topics	Web Link
1	Molecular Mechanics-Force Field	https://youtu.be/gP6HfBQ_LkI
2	Pahrmacophore modeling	https://youtu.be/wZd-oNpzNTc
3	Target based drug design	https://youtu.be/qWAiowXvko0
4.	Data Analysis for Biologists	https://onlinecourses.nptel.ac.in/noc22_bt20/

C. Reference Book(s)

1. Introduction to Bioinformatics with R : A practical guide for Biologists,Edward Curry,Chapman & Hall,2020.

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1.	Pair wise alignment: a. Position-Specific Iterated (PSI)- BLAST b. Pattern-Hit Initiated (PHI)-BLAST c. Domain Enhanced Lookup Time Accelerated-BLAST (DELTA-BLAST)	Critique the outputs of specialized BLAST	K4
2	Multiple sequence alignment: a. Small Sequences – T-Coffee b. Medium Sequences - MUSCLE c. Large Sequences - MAFFT	Categorize various multiple sequence alignment tools based on the outputs	K4
3	Sequence patterns and profiles: a. SCanProsite b. PRATT	Demonstrate the sequence pattern and profile search	K3
4	Protein motif and domain analysis: a. MEME/MAST b. eMotif c. InterproScan d. ProSite e. ProDom f. Pfam	Inspect the outputs of various motif and domain analysis tools	K4
5	Phylogenetic analysis – MEGA, PAUP, PHYLIP	Relate multiple sequences based the phylogeny	K4
6	Drawing chemical structure using ChemSketch	Design novel small molecules for optimization	K5

Unit/ Section	Course Content	Learning Outcomes	HBTLT
7	Conversion of 2D to 3D: Open Babel	Formulate the drawn small molecules for docking studies	K5
8	Molecular Docking: AUTODOCK TOOLS	Perform docking for the existing biomolecules	K3
9	Post Docking Analysis: LIGPLOT. PoseView,	Analyze the protein-ligand interactions	K4

Unit/ Section	Course Content	Learning Outcomes	HBLT
1.1	Calculation of measures of central tendency	Recall the concept of arithmetic mean, geometric mean and harmonic mean	K1
		Calculate arithmetic mean, geometric mean and harmonic mean	K4
1.2	Calculation of measures of dispersion	Test the measures of dispersion	K4
		Calculate the range, standard deviation, variance and coefficient of variance	K4
1.3	Graphical display of data	Sketch the given data graphically using the concept of bar diagram and pie-chart	K3
1.3	Analysing data using tables	Employ the given data in table format	K3
2.1	Binomial distribution	Identify the probability of 'x' successes in N trials	K2
		Quantify the solution using binomial distribution	K4
2.2	Normal distribution	Describe how the values of a variable are distributed	K2
2.3	Poisson distribution	Calculate the probability of an event occurring over a certain interval	K4
2.4	One sample t-test	Critique the concepts of hypothesis and null hypothesis	K2
		Interpret whether the sample mean is statistically different from a known or hypothesized population mean.	K2
2.5	One-way between groups ANOVA	Experiment the difference between the means of more than two groups.	K4
2.6	Bivariate correlation	Explain the concept of correlation	K2
		Demonstrate the existence of relationships between two different variables	K3
2.7	Rank correlation	Solve the problems using the concept of rank correlation coefficient	K2

Unit/ Section	Course Content	Learning Outcomes	HBLT
2.8	Regression	Describe regression analysis	K2
		Analyze the associative relationship between dependent variable and one or more independent variable	K4
		Relate the regression model with hypothesis test and interpret the result	K4

4. Mapping Scheme

I20BI	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low M: Medium H: High

5. Course Assessment Methods

Direct:

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect:

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Elec V : Basics Of Next Generation Sequencing

Semester : VIII **Course Code :I23BI8:A**

Credits : 4 **Hours : 5**

1. Course Outcomes

After completion of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall the history of DNA sequencing	K1	I
CO2	Describe the basic principles and applications of NGS	K2	II
CO3	Discuss the different methodologies for DNA sequence analysis	K2	III
CO4	Employ bioinformatics skills and tools for NGS data analysis	K3	IV
CO5	Discuss the methodologies of RNA-Seq data analysis	K2	IV
CO6	Inspect histone modification sites from ChIP-seq data	K4	V

2A. Syllabus

Unit I–Introduction to DNA Sequencing **15 Hours**

1.1. History and types of DNA sequencing: Maxam-Gilbert method, Sanger method
1.2. Automated DNA sequencing
1.3. High throughput Sequencing and its types
1.4. Human Genome Project and its outcome.

Unit II–Introduction to NGS **15 Hours**

2.1. What is NGS?, Typical NGS experimental workflow
2.2. Ins and Outs of different NGS platforms – Illumina reversible dye-terminator sequencing, Ion torrent semiconductor sequencing, Pacific biosciences single molecule real-time (SMRT) sequencing
2.3. Experimental considerations for NGS
2.4. Biases and factors affecting NGS data accuracy
2.5. Major applications of NGS.

Unit III–Methodology of NGS **15 Hours**

3.1. Common steps in NGS data analysis: Base calling, base quality score and recalibration
3.2. Reads mapping: mapping approaches, mapping algorithms and its selection with reference genome sequences

3.3. SAM/BAM mapping file format, mapping file examination and operation

3.4. NGS data management analysis: storage, transfer and sharing

3.5. Hardware and software with bioinformatics skills required for NGS data analysis.

Unit IV–Introduction to Transcriptomics **15 Hours**

4.1 Transcriptomics by RNA-Seq: principle, experimental design, RNA-Seq data analysis

4.2. Applications of RNA-Seq, steps in small RNA sequencing

4.3. Whole genome resequencing: Genotyping and genomic variation discovery

4.4. De novo genome assembly: genomic factors and sequencing strategies

4.5. Assembly of contigs, scaffolding, assembly quality evaluation, gap closure and limitations.

Unit V - Introduction to Epigenetics **15 Hours**

5.1. AnalysingChIP-seq data: preprocessing, normalization, differential identification and binding pattern characterization

5.2. Types of histone modifications

5.3. Identifying differential histone modification sites from ChIP-seq data

5.4. Epigenetic analysis: ChIP-chip and ChIP-seq.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Human Genome Project	https://www.youtube.com/watch?v=-hryHoTIHak
2	Types of NGS Platforms	https://www.youtube.com/watch?v=SPHU3UjF1ik
3	NGS Data Analysis	https://www.youtube.com/watch?v=l4BAfRekohk
4	Whole Genome Sequencing	https://www.youtube.com/watch?v=IL0xRVhLyf0
5	Histone Modifications	https://www.youtube.com/watch?v=ImcomFPgJO4

C. Text Book(s)

1. AnjanaMunshi, DNA Sequencing- Methods and Applications, InTech, 2012.

2. Xinkun Wang, Next-Generation Sequencing Data Analysis, CRC press, 2016.

3. Junbai Wang, AikChoon Tan, TianhaiTian, Next Generation Microarray Bioinformatics – Methods and Protocols, Springer Protocols, Humana Press, 2012.

4. Lee-Jun C. Wong, Lisa D. White, Next Generation Sequencing- Translation to Clinical Diagnostics, Springer, 2013

D. Weblinks

1. https://www.udemy.com/course/next-generation-sequencing-guide- for-beginners-h/
2. https://www.udemy.com/course/chipseq-course/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
	1 Introduction to DNA Sequencing		
1.1	History and types of DNA sequencing: Maxam-Gilbert method, Sanger method	Recall the types of DNA sequencing	K1
1.2	Automated DNA sequencing	Describe the basics of automated DNA sequencing	K2
1.3	High throughput Sequencing and its types	List the types of High throughput sequencing	K1
1.4	Human Genome Project and its outcome	Discuss the uses of HGP	K2
	2 Introduction to NGS		
2.1	What is NGS?, Typical NGS experimental workflow	Sketchout the flow chart of a typical NGS experimental workflow	K3
2.2	Ins and Outs of different NGS platforms – Illumina reversible dye-terminator sequencing, Ion torrent semiconductor sequencing, Pacific biosciences single molecule real-time (SMRT) sequencing	Report the different types of NGS platforms	K2
2.3	Experimental considerations for NGS	Analyze the experimental considerations for NGS	K4
2.4	Biases and factors affecting NGS data accuracy	Summarize the factors affecting NGS data accuracy	K2
2.5	Major applications of NGS	Explain the applications of NGS	K2
	3 Methodology of NGS		
3.1	Common steps in NGS data analysis: Base calling, base quality score and recalibration	Discuss the steps of NGS analysis	K2
3.2	Reads mapping: mapping approaches, mapping algorithms and its selection with reference genome sequences	State the various mapping approaches for NGS analysis	K1
3.3	SAM/BAM mapping file format, mapping file examination and operation	Use of various mapping file formats in NGS analysis	K3

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3.4	NGS data management analysis: storage, transfer and sharing	Explain the methodology of transfer, storing and sharing the NGS data	K2
3.5	Hardware and software with bioinformatics skills required for NGS data analysis	Describe the tools and skills required for NGS analysis	K2
4	**Introduction to Transcriptomics**		
4.1	Transcriptomics by RNA-Seq: principle, experimental design, RNA-Seq data analysis	Explain the basics of trancriptomics by RNA-Seq	K2
4.2	Applications of RNA-Seq, steps in small RNA sequencing	List the applications of RNA-Seq	K1
4.3	Whole genome resequencing: Genotyping and genomic variation discovery	Describe the whole genome resequencing	K2
4.4	De novo genome assembly: genomic factors and sequencing strategies	Discuss the factors and strategies involved in De novo genome assembly	K2
4.5	Assembly of contigs, scaffolding, assembly quality evaluation, gap closure and limitations	Use RNA-seq to perform gene editing by assembling contigs and scaffolds	K3
5	**Introduction to Epigenetics**		
5.1	Analysing ChIP-seq data: preprocessing, normalization, differential identification and binding pattern characterization	Explain the steps involved in ChIP-seq data	K2
5.2	Types of histone modifications	List the types of histone modifications	K1
5.3	Identifying differential histone modification sites from ChIP-seq data	Analyze the steps involved in identifying histone modifications sites	K4
5.4	Epigenetic analysis: ChIP-chip and ChIP-seq	Relate the epigenetic analysis with transcriptomic analysis	K4

4. Mapping Scheme

I23BI8:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	L	L	-	-	M	L	M	L	L	M
CO2	M	M	M	L	L	-	-	M	L	M	L	L	M
CO3	M	M	M	L	L	-	-	M	L	M	L	L	M
CO4	L	L	L	M	L	-	-	L	L	M	L	L	M
CO5	L	L	L	M	L	-	-	L	L	M	L	L	M
CO6	L	L	L	M	L	-	-	L	L	M	L	L	M

5. Course Assessment Methods

Direct:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect:

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Elec V : Herbal Medicine

Semester : VIII | **Course Code I23BI8:B**

Credits : 4 | **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Tell the history of herbal medicine and its evolution	K1	I
CO2	Discuss about the common medicinal systems that are practiced in ancient India	K2	II
CO3	Discuss about the different systems of medicine that are practiced throughout the world	K2	III
CO4	Explain the concept of holistic medicine	K2	IV
CO5	Describe the global impact of herbal medicine	K2	V
CO6	Summarize the databases on herbals and herbal drugs	K2	V

2. A. Syllabus

Unit I–Evolution of Medicine **15 Hours**

1.1 Evolution of conscious use of plants in the management of health and disease – The Alma – Ata Declaration – The World Health Organization (WHO)

1.2 The need for the study of herbals and herbal medicine: Rescue and Preservation of traditional medicinal knowledge and herbals,

1.3 Understanding the potential and option values of hitherto unknown/ yet to be evaluated herbals

1.4 Understanding mode of action, synthesis and designing of herbal drugs - Pharmacodynamics - Improvement of drugs.

Unit II–Types of Medicine Systems **15 Hours**

2.1 Systems of Medicine – Evolution of systems of medicine – Allopathy

2.2 Alternative and complementary medicinal stems – Ayurveda : dimensions, encyclopaedic source texts, eight chikitsas, philosophical and theoretical bases, The Ayurvedic Pharmacopoeia and MateriaMedica, Principles and strategies of ayurvedic treatment

2.3 Types of therapies and treatment methods, current research trends.

Unit III –Siddha Medicine System **15 Hours**

3.1 The Siddha system of medicine : dimension, source texts, philosophical and theoretical bases, Siddha Pharmacopoeia and MateriaMedica, Principles and strategies of treatment, current research trends

3.2 The Unani, Chinese, Tibetan, Babylonian and Egyptian Systems of medicine – Homeopathy.

Unit IV –Holistic Medicine System **15 Hours**

4.1 Naturopathy, Aromotherapy, Bach's flower remedies, Tribal medicine, Faith healing, Religious beliefs

4.2 Ethnotherapeutics and Ethnopharmacology – Concept of Holistic medicine – Common herbals and herbal medicines of India.

Unit V –Global Impact of Herbal Medicine **15 Hours**

5.1 Economic value of herbals and herbal drugs, wealth of Indian and World herbals, standardization and preservation of herbal drugs.

5.2 Drug adultreration, identification and substitutions,

5.3 Identification, cultivation and micropropagation of herbals, biotechnological exploitation, Databases on herbals and herbal drugs.

B. Topics for Self Study:

S.No	Topics	Weblinks
1	Herbal Medicine Programs	https://www.youtube.com/watch?v=N8B3NCTSuXM
2	Naturopathy and Yoga	https://www.youtube.com/watch?v=h59MYmayfVM
3	Ayurveda Over Western Medicines	https://www.youtube.com/watch?v=HzTvEK1sVi0
4	Adulteration of Herbal Drugs	https://www.youtube.com/watch?v=iI75ME6dFTw

C. Text Book(s)

1. Kanny, Lall, Dey and Raj Bahadur, The indigenous drugs of India, International Book Distributers, 1984.
2. Agnes Arber, Herbal plants and Drugs. Mangal Deep Publications. 1999.
3. Wagner H. and Wolff P., New Natural products and Plant drugs with Pharmacological, Biological (or) therapeutical activity. Springer, New Delhi. 1979.

D. Reference Book(s)

1. GuhabakshiD.N.,Sensarma and Pal D.C., A lexicon of medicinal plants in India. Nayaprokash - publications. 1999.
2. ChopraR.N.,NayarS.L.andChopraI.C.,Glossary of Indian medicinal plants. C.S.I.R, New Delhi. 1956.
3. Rajiv K.Sinha. EthnobotanyThe Renaissance of Traditional Herbal Medicine. INA SHREE publishers. 1996.
4. Kanny, Lall, Dey and Raj Bahadur, The indigenous drugs of India, International Book Distributers, 1984.
5. Agnes Arber, Herbal plants and Drugs.Mangal Deep Publications. 1999.
6. Wagner H. and Wolff P., New Natural products and Plant drugs with Pharmacological, Biological(or) therapeutical activity. Springer, New Delhi. 1979.
7. SivarajanV.V. and BalachandranIndra, Ayurvedic drugs and their plant source. Oxford IBH publishing Co. 1994
8. Miller, Light and Miller, Bryan, Ayurveda and Aromatherapy. Banarsidass, Delhi. 1988.
9. Anne Green, Principles of Ayurveda. Thorsons, London. 2000.

E. Weblinks

1. https://nptel.ac.in/courses/121/106/121106003/
2. https://www.coursera.org/learn/herbalmedicine
3. https://onlinecourses.swayam2.ac.in/cec19_bt10/preview

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Evolution of Medicine		
1.1	Evolution of conscious use of plants in the management of health and disease – The Alma – Ata Declaration – The World Health Organization (WHO)	Recall the evolution of conscious use of plants in the management of health and disease	K1
1.2	The need for the study of herbals and herbal medicine: Rescue and Preservation of traditional medicinal knowledge and herbals	Identify the need for the study of herbs and herbal medicine	K2
1.3	Understanding the potential and option values of hitherto unknown/ yet to be evaluated herbals	Discuss the potential and option values of hitherto unknown	K2
1.4	Understanding mode of action, synthesis and designing of herbal drugs - Pharmacodynamics - Improvement of drugs.	Illustrate the mode of action of herbal drugs	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2	**Types of Medicine Systems**		
2.1	Systems of Medicine – Evolution of systems of medicine – Allopathy – Alternative and complementary medicinal stems – Ayurveda : dimensions, encyclopaedic source texts, eight chikitsas, philosophical and theoretical bases	Tell the fundamentals of medicinal systems	K1
2.2	The Ayurvedic Pharmacopoeia and MateriaMedica, Principles and strategies of ayurvedic treatment	Describe the principles and strategies of ayurvedic treatment	K2
2.3	Types of therapies and treatment methods, current research trends.	List the types of therapies and treatment in Ayurveda	K1
3	**Siddha Medicine System**		
3.1	The Siddha system of medicine : dimension, source texts, philosophical and theoretical bases, Siddha Pharmacopoeia and MateriaMedica Principles and strategies of treatment, current research trends	Describe the basis of siddha system of medicine Explain the Strategies of treatment in Siddha	K2
3.2	The Unani, Chinese, Tibetan, Babylonian and Egyptian Systems of medicine – Homeopathy.	Discuss the significance of various types of medicinal systems	K2
4	**Holistic Medicine System**		
4.1	Naturopathy, Aromotherapy, Bach's flower remedies, Tribal medicine, Faith healing, Religious beliefs,	Explain the basics of Naturopathy	K2
4.2	Ethnotherapeutics and Ethnopharmacology – Concept of Holistic medicine – Common herbals and herbal medicines of India	Describe the Concept of Holistic medicine	K2
5	**Global Impact of Herbal Medicine**		
5.1	Economic value of herbals and herbal drugs, wealth of Indian and World herbals, standardization and preservation of herbal drugs.	List the pros of herbals and herbal drugs	K1
5.2	Drug adulteration, identification and substitutions,	Define Drug adulteration	K1
5.3	Identification, cultivation and micropropagation of herbals, biotechnological exploitation, Databases on herbals and herbal drugs.	Summarize the databases on herbals and herbal drugs	K2

4. **Mapping Scheme**

I23BI8:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	L	M	L	L	L	M	L	L	M
CO2	L	L	L	L	L	M	L	L	L	M	L	L	M
CO3	L	L	L	L	L	M	L	L	L	M	L	L	M
CO4	L	L	L	L	L	M	L	L	L	M	L	L	M
CO5	L	L	L	L	L	M	L	L	L	M	L	L	M
CO6	L	L	L	M	L	M	L	L	L	M	M	M	M

L: Low **M: Medium** **H: High**

5. **Course Assessment Methods**

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. Jebastin

Elec VI : Systems Biology

Semester : VIII **Course Code : I23BI8:C**

Credits : 4 **Hours/Week : 5**

1. Course Outcomes

After completion of this course student would be able to

CO. No	Course Outcomes	Level	Unit
CO1	Discuss the concepts in Biological Systems and analyze its network construction	K4	I
CO2	Employ enzyme kinetics and thermodynamics	K3	II
CO3	Categorize the algorithms involved in metabolic regulation	K4	III
CO4	Differentiate the metabolic pathways within living organisms using systems biology databases	K4	IV
CO5	Device modeling tools for constructing gene and protein network	K5	IV
CO6	Apply the concepts of synthetic biology in various fields and investigate its real time application in computational Biology	K6	V

2. A. Syllabus

Unit I - Introduction to Systems Biology and Biological Networks 15 Hours

1.1 Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems - Introduction to Biological Networks and Basic Concepts – Metabolic, Signaling and Regulatory networks-Pathways types and methods.

1.2 Characterizing dynamic states - Formulating and studying dynamic network models - Properties of dynamic states - Network structure versus dynamics Systems Biology

1.3 Selforganizing maps and Connectivity maps - definition and its uses.

Unit II - Standard models and approaches in systems biology 15 Hours

2.1 Metabolism- enzyme kinetics and thermodynamics- Michaelis-Menten Kinetics

2.2 Metabolic networks- metabolic control analysis - Signal transduction- introduction- function and structures interactions- structural components

2.3 Signaling selected biological processes - mathematical models - prediction of biological systems.

Unit III - Simulation of pathways and algorithms **15 Hours**

3.1 Whole cell: Principle and Level of simulation – E-cell and v-cell, Virtual Erythrocytes. Pathological analysis.

3.2 Flux Balance Analysis. Biochemical metabolic pathways, Metabolomics and enzymes.Interconnection of pathways, metabolic regulation.

3.3 Clustering Algorithms -Clustering Algorithms-Hierarchical Clustering- Self-organizing Maps (SOMs).K-means- Validation of Gene Expression

3.4 Publication in the Era of Systems Biology- Systems Biology and Text Mining. Systems Biology in Medicine and Drug Development- Guiding the Design of New Organisms -Computational Limitations- Potential Dangers

Unit IV - Systems Biology databases and modelling tools **15 Hours**

4.1 Databases-Gene Ontology, KEGG, BRENDA, EMP, MetaCyc, AraCyc, EcoCyc ,Expression databases and various databases related to systems biology- Databases of the National Center for Biotechnology ,Databases of the European Bioinformatics Institute,EMBL Nucleotide Sequence Database,Ensembl,Reactome,TRANSFAC and Genome Matrix

4.2 Modeling Tools -Modeling and Mathematica and Matlab,Gepasi , E-Cell, PyBioS ,Systems Biology Workbench, JDesigner, Cell Designer,Cytoscape

4.3 PetriNets, Systems Biology Markup Language-Protein-Protein interaction, STRING,BIOGRID, STITCH -Virtual cell - virtual rice project.

Unit V - Introduction to Synthetic Biology **15 Hours**

5.1 Introduction – Definition – Synthetic Biology versus Systems Biology - Synthesis and Engineering Tools - DNA Synthesis

5.2 Protein Engineering - Pathway Engineering - Genome Engineering

5.3 Computational and Theoretical Tools – Genomics, Proteomics and Metabolomics Tools

5.4 Applications in Synthetic Biology – Molecular, Pathway and Whole Cell Level - Challenges and Future Perspectives.

B. Topics for Self Study:

S.No	Topics	Web Links
1.	Deep Learning on Single-Cell Sequencing Data	http://www.drugdiscovery.net/
2.	Machine learning on molecular data	https://www.edureka.co/executive-programs/machine-learning
3.	Science Transforming Health in Systems biological view	www.Systemsbiology.Org
4.	Network analysis in Biology	https://www.coursera.org/

C. Text Book(s)

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press,2001.
2. Systems Biology in practice: Concepts, Implementation and applications by E.KlippR.Herwig, A.Kowlad, C.Wierling and H.Lehrach, Wiley InterScience. 2005
3. Computational Systems Biology by A.Kriete, R. Eils, Academic Press. 2005
4. Huimin Zhao (Ed.), Synthetic Biology: Tools and Applications, Academic Press, Elsevier, USA,2013.

D. Reference Book(s)

1. Systems Biology: Definitions and Perspectives by L. Alberghina H.V. Westerhoff., Springer.2005
2. Bernhard Ø. Palsson, Systems Biology – Simulation of Dynamic Network States, Cambridge Univ. Press, UK,2011.
3. Jing Liang, YunziLuo, and Huimin Zhao, Synthetic biology: putting synthesis into biology, Wiley Interdiscip Rev SystBiol Med, 3,7-20,2011.
4. Systems Biology: Definitions and Perspectives by L. Alberghina H.V. Westerhoff., Springer.2005

E. Weblinks

1. https://nptel.ac.in/courses/102/106/102106035/
2. https://onlinecourses.nptel.ac.in/noc20_bt08/preview
3. https://nptel.ac.in/courses/102/103/102103056/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to Systems Biology and Biological Networks**		
1.1	Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems - Introduction to Biological Networks and Basic Concepts – Metabolic, Signaling and Regulatory networks-Pathways types and methods.	Describe the basis of Systems Biology Analyze the construction of types of Biological networks	K2 K4
1.2	Characterizing dynamic states - Formulating and studying dynamic network models - Properties of dynamic states - Network structure versus dynamics Systems Biology	Explain the concepts of dynamic network in Systems Biology	K2
1.3	Selforganizing maps and Connectivity maps - definition and its uses.	List the types of maps required for network construction	K1

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2	**Standard models and approaches in systems biology**		
2.1	Metabolism- enzyme kinetics and thermodynamics- Michaelis-Menten Kinetics	Describe the mechanism of enzyme kinetics	K2
2.2	Metabolic networks- metabolic control analysis - Signal transduction- introduction- function and structures interactions- structural components	Explain the concepts and functions of metabolic networks	K2
2.3	Signaling selected biological processes - mathematical models - prediction of biological systems.	Apply the mathematical models for predicting biological system	K3
3	**Simulation of pathways and algorithms**		
3.1	Whole cell: Principle and Level of simulation – E-cell and v-cell, Virtual Erythrocytes. Pathological analysis.	Compare the efficiency of E-cell and V-cell simulation	K2
3.2	Flux Balance Analysis. Biochemical metabolic pathways, Metabolomics and enzymes. Interconnection of pathways, metabolic regulation.	Analyze the steps of constructing metabolic pathways	K4
3.3	Clustering Algorithms -Clustering Algorithms-Hierarchical Clustering- Self-organizing Maps (SOMs).K-means- Validation of Gene Expression	Practice various algorithms used to validate the gene expression	K3
3.4	Publication in the Era of Systems Biology- Systems Biology and Text Mining. Systems Biology in Medicine and Drug Development- Guiding the Design of New Organisms -Computational Limitations- Potential Dangers	Relate the importance of Systems Biology in drug development	K4
4	**Systems Biology databases and modelling tools**		
4.1	Databases-Gene Ontology, KEGG, BRENDA, EMP, MetaCyc, AraCyc, EcoCyc ,Expression databases and various databases related to systems biology-Databases of the National Center for Biotechnology ,Databases of the European Bioinformatics Institute,EMBL Nucleotide Sequence Database ,Ensembl ,Reactome,TRANSFAC and Genome Matrix	Categorize different types of Systems Biological databases	K4
4.2	Modeling Tools -Modeling and Mathematical and Matlab,Gepasi , E-Cell, PyBioS ,Systems Biology Workbench, JDesigner , CellDesigner ,Cytoscape	Categorize various modeling tools for biological systems	K4
4.3	Petri Nets,Systems Biology Markup Language-Protein-Protein interaction,STRING, BIOGRID, STITCH -Virtual cell - virtual rice project.	Device the online tools for visualizing protein- protein interaction network	K3
5	**Introduction to Synthetic Biology**		
5.1	Introduction – Definition – Synthetic Biology versus Systems Biology - Synthesis and Engineering Tools - DNA Synthesis	Describe the basis of Synthetic Biology	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5.2	Protein Engineering - Pathway Engineering - Genome Engineering	Apply the concepts of Synthetic Biology in Protein and Genome Engineering	K3
5.3	Computational and Theoretical Tools – Genomics, Proteomics and Metabolomics Tools	Report on various computational tools for macromolecular analysis	K6
5.4	Applications in Synthetic Biology – Molecular, Pathway and Whole Cell Level - Challenges and Future Perspectives.	Establish the challenges and future perspectives of Synthetic Biology	K

4. Mapping Scheme

I23BI8:C	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	M	L	H	M	H	H	H	H
CO2	M	M	L	M	L	-	-	M	M	M	M	M	M
CO3	H	L	L	H	L	L	L	M	L	H	H	H	H
CO4	H	H	M	M	L	L	L	H	M	H	H	H	H
CO5	H	H	M	M	L	M	L	H	M	H	H	H	H
CO6	H	H	M	M	L	M	L	H	M	H	H	H	H

L: Low M: Medium H: High

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

Elec VI: Research Methodology, Bioethics, Biosafety and IPR

Semester : VIII **Course Code : I23BI8:D**
Credits : 4 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	List the research approaches	K1	I
CO2	Practice thesis and research report writing.	K3	II
CO3	Discuss the significance of Bioethics	K2	III
CO4	Summarize the biosafety guidelines	K2	IV
CO5	Analyze the importance of IPR	K4	V
CO6	Justify the importance of patent filing	K6	V

2. A. Syllabus

Unit I -Research Methodology **15 Hours**

1.1 Research-Introduction, Meaning
1.2 Objective
1.3 Types,
1.4 Research approaches,
1.5 Significance of Research
1.6 Research methods versus Methodology,
1.7 Research and Scientific Methods,
1.8 Research Process,
1.9 Criteria of Good Research.

Unit II - Academic Writing & Presentation **15 Hours**

2.1 Basic knowledge of funding agencies,
2.2 Proposal submission for funding agencies,
2.3 Organization of proposals, Research report writing,
2.4 Submission of research articles for Publication to Reputed journals,
2.5 Thesis writing, and
2.6 Research report writing,
2.7 Interpretation-Meaning, Technique and Precautions,
2.8 Significance of Report writing,
2.9 Layout of the Research Report,
2.10 Types of Reports, Ethical and

2.11 Moral Issues in Research,
2.12 Plagiarism, tools to avoid plagiarism,
2.13 Oral presentation.

Unit III - Bioethics **15 Hours**

3.1 Introduction to Bioethics, Need and Definition of Bioethics,
3.2 Branch and Application of Bioethics,
3.3 Human Genome project and its Ethical issues, Ethical, Legal and
3.4 Social Implications of Human Genome Project,
3.5 ELSI Establishment, ELSI Research Goals,
3.6 Genetics Studies on Ethnic Races, Use of Animals in Research
3.7 Testing and Alternative for Animal Research,
3.8 Animal and Human cloning and their Ethical Aspects,
3.9 Testing of Drugs on Human Volunteers,
3.10 Organ Transplantation and Ethical Issues.

Unit IV - Biosafety **15 Hours**

4.1 Introduction to Biosafety,
4.2 Need and Definition of Biosafety,
4.3 Level and Application of Biosafety,
4.4 National Institute of Health Guideline , Biosafety guidelines in India,
4.5 Guidelines for Research in Transgenic Organisms,
4.6 Issues in use of Genetically Modified Organisms,
4.7 Genetically Modified Organisms into the Environment,
4.8 Public and NGO participation in Biosafety and protection Biodiversity

Unit V - Intellectual Property Right and Patent **15 Hours**

5.1 IPR-Introduction,
5.2 Forms of Intellectual Property,
5.3 International and Regional agreement,
5.4 Treaties in IPR, IPR related legislations in India,
5.5 IPR problems and its hindrance to Diffusion
5.6 Agricultural Biotechnology,
5.7 Introduction and History of Indian system and law,
5.8 Types of Patent, Requirement of Patent, Patents in India, Drug Patent in India,
5.9 Various types of Patent and Application in India.

B. Topics for Self Study:

S.No	Topics	References/Weblink
1	Overview of literature survey	https://www.youtube.com/watch?v=Yzfl3rtF0SM&feature=emb_logo
2	Literature survey using scopus	https://www.youtube.com/watch?time_continue=1&v=JyYb6V8mUdc&feature=emb_logo
3	Tutorial on using Microsoft word with endnote entries	https://www.youtube.com/watch?v=wuKCgEdpAXU&feature=emb_logo
4	Experimental skills	https://www.youtube.com/watch?v=RcGy2N6KePA&feature=emb_logo
5	Data analysis	https://www.youtube.com/watch?v=hskr2Tb-7k0&feature=emb_logo

C. Text Book(s)

1. C R Kothari, GauravGarg, Research Methodology, Methods and Techniques(Third Edition), New Age International Publishers 2014
2. M. K. Sateesh, Bioethics and Biosafety , I. K. International Pvt Ltd 2013

D. Reference Book(s)

1. Vinayak Bairagi, Mousami V. Munot , Research Methodology: A Practical and Scientific Approach, 2019.

E. Weblinks

1. https://nptel.ac.in/courses/121/106/121106007/
2. https://onlinecourses.nptel.ac.in/noc21_hs85/preview
3. https://nptel.ac.in/courses/110/105/110105139/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Research Methodology		
1.1	Research-Introduction, Meaning	Define research	K1
1.2	Objective	Explain the purpose of Research	K2
1.3	Types	Classify the types of research	K2
1.4	Research approaches	Distinguish between quantitative and qualitative research	K4
1.5	Significance of Research	state the significance of research	K1

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1.6	Research methods versus Methodology	List out the various research methods and methodologies	K1
1.7 1.8 1.9	Research and Scientific Methods Research Process Criteria of Good Research	Explain the qualities of good research	K2
2	**Academic Writing & Presentation**		
2.1 2.2 2.3	Basic knowledge of funding agencies Proposal submission for funding agencies Organization of proposals	Describe the skills of writing a research proposal	K2
2.4 2.5	Research report writing Submission of research articles for Publication to Reputed journals	Explain the main steps involved in research report writing and submission	K2
2.6	Thesis writing, and Research report writing	Explain the different sections in thesis writing and report writing	K2
2.7	Interpretation-Meaning, Technique and Precautions	Categorize the data	K4
2.8 2.9 2.10	Significance of Report writing Layout of the Research Report Types of Reports	Practice report writing	K3
2.11 2.12	Ethical and Moral Issues in Research Plagiarism, tools to avoid plagiarism	Analyze ethical and practical challenges of sharing data	K4
2.13	Oral Presentation	Develop oral presentation skills	K5
3	**Bioethics**		
3.1 3.2	Introduction to Bioethics, Need and Definition of Bioethics Branch and Application of Bioethics	Explain the fundamentals and importance of bioethics	K2
3.3 3.4	Human Genome project and its Ethical issues Ethical, Legal and Social Implications of Human Genome Project	Explain the Privacy issues of having a massive databank with DNA information of millions of people	K2
3.5	ELSI Establishment, ELSI Research Goals	State the importance of ELSI in human genome project	K2
3.6	Genetics Studies on Ethnic Races	Recall the recent discoveries in genetic studies	K1

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3.7 3.8	Use of Animals in Research Testing and Alternative for Animal Research Animal and Human cloning and their Ethical Aspects	Discuss the need for alternative animal models	K2
3.9 3.10	Testing of Drugs on Human Volunteers Organ Transplantation and Ethical Issues	Discuss the importance of bioethics in human clinical trials	K2
4	**Biosafety**		
4.1	Introduction to Biosafety	Define Biosafety	K1
4.2	Need and Definition of Biosafety	Summarize the importance of biosafety	K2
4.3	Level and Application of Biosafety	Classify the Biosafety Level	K2
4.4	National Institute of Health Guideline , Biosafety guidelines in India	Compare and discuss the different biosafety guidelines	K2
4.5 4.6 4.7	Guidelines for Research in Transgenic Organisms Issues in use of Genetically Modified Organisms Genetically Modified Organisms into the Environment	List the guidelines for research in transgenic organisms	K1
4.8	Public and NGO participation in Biosafety and protection Biodiversity	Discuss the role of public and NGO participation in Biosafety and protection biodiversity	K2
5	**Intellectual Property Right and Patent**		
5.1	IPR-Introduction	Analyze IPR and its importance	K4
5.2	Forms of Intellectual Property	Explain the four primary forms of intellectual property rights.	K2
5.3	International and Regional agreement	Categorize the various organizations associated with IPR	K4
5.4 5.5 5.6	Treaties in IPR, IPR related legislations in India IPR problems and its hindrance to Diffusion of Agricultural Biotechnology Introduction and History of Indian system and law	Review the ethical and professional issues which arise in the intellectual property law contect	K6

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
5.7	Types of Patent, Requirement of Patent	Report on the types of Patent and Application in India	K6
5.8	Patents in India, Drug Patent in India		
5.9	Various types of Patent and Application in India		

4. Mapping Scheme

I23BI8:D	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	L	M	-	-	L	L	L	-	-	H
CO2	L	L	L	L	M	-	-	L	L	L	-	-	H
CO3	L	L	L	L	M	-	-	L	M	L	-	-	H
CO4	L	L	L	L	M	-	-	L	M	L	-	-	H
CO5	L	L	L	L	M	-	L	L	L	L	-	-	H
CO6	L	L	L	L	M	-	L	L	L	L	-	-	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

Core XV : Genomics and Proteomics

Semester : IX **Course Code : I23BI915**

Credits : 5 **Hours / Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the genome sequencing methods and explain the sequence assembly	K2	I
CO2	Discuss how the location of genes is identified with the help of HGP	K2	I
CO3	Summarize the methods and markers involved in genome mapping	K2	II
CO4	Relate the microarray technology in predicting gene expression	K4	III
CO5	Analyze the tools and techniques involved in protein and peptide analysis	K4	IV
CO6	Review the databases and tools that are used for proteomic study	K6	V

2. A. Syllabus

Unit I – Basics of Genomics **15 Hours**

1.1 **Genome sequencing:** The Methodology for DNA Sequencing-Chain termination DNA sequencing- Alternative methods for DNA sequencing- Chemical degradation sequencing-Pyrosequencing is used for rapid determination of very short sequences

1.2 **Assembly of a Contiguous DNA Sequence:** Sequence assembly by the shotgun method - Sequence assembly by the clone contig method - Whole-genome shotgun sequencing

1.3 **The Human Genome Project** -Sequencing the human genome -The future of the human genome project.

1.4 **Understanding a Genome sequence**: Locating the genes in a Genome Sequence, Gene location by Sequence Inspection, Experimental Techniques for Gene Location, Determining the Functions of Individual Genes.

Unit II - Mapping Genomes-Genetic and Physical Maps **15 Hours**

2.1 Genetic Mapping- DNA markers for genetic mapping-RFLP, SSLP, SNP

2.1.1 Linkage analysis is the basis of genetic mapping-Linkage analysis with different types of organism-Gene mapping by human pedigree analysis-Genetic mapping in bacteria.

2.2 Physical Mapping -Restriction mapping- FISH- STS mapping

Unit III - Genome Anatomies **15 Hours**

3.1 Eukaryotic Nuclear Genomes

The Genetic Features of Eukaryotic Nuclear Genomes- Gene organization in other eukaryotes -The human gene catalog -Families of genes -Pseudogenes and other evolutionary relics -The repetitive DNA content of eukaryotic nuclear genomes-Minisatellites and microsatellites-Interspersed repeats.

3.2 Techniques in Functional Genomics

Microarray Technology- Functional Bioinformatics Analyses of Microarray Data- Feature Extraction (Image Processing)- Quality Control-Normalization-Differential Expression Analysis- Biological Interpretation of Gene Expression Data- Submission of Data to a Public Repository-Applications and Limitations of Microarrays -Tools and Databases

Unit IV –Basics of Proteomics **15 Hours**

4.1 Proteomics and its techniques

Proteomics and the New Biology- The Proteome-Tools of Proteomics - Analytical Protein and Peptide Separations- Protein Digestion Techniques

4.2 Mass Spectrometer for Protein and Peptide Analysis -Protein Identification by Peptide Mass Fingerprinting -Peptide Sequence Analysis by Tandem Mass Spectrometry -Protein Identification with Tandem Mass Spectrometry Data

Unit V - Proteomics databases and its applications **15 Hours**

5.1 Mining Proteomes – Protein expression Profiling-Protein–Protein Interactions-Protein–Protein Interaction Databases- Mapping Protein Modifications -2D gel databases- Protein identification programs – Muscot – Peptldent – Protein prospector – GFS.

5.2 Application of proteomics to medicine, toxicology and pharmaceuticals.

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Algorithms for DNA Sequencing	https://www.coursera.org/learn/dna-sequencing
2	Introduction to Genomic Technologies	https://www.coursera.org/learn/introduction-genomics
3	Genome: Unlocking Life's Code	https://www.youtube.com/watch?v=xeAv0zKalaM
4	Genomics: Decoding the Universal Language of Life	https://www.coursera.org/learn/genomics-research
5	Quantification in Proteomics	https://www.coursera.org/lecture/experimental-methods/lecture-3-quantification-in-proteomics-n7Z1J
6	Mass spectrometry based proteomics	https://www.classcentral.com/course/swayam-mass-spectrometry-based-proteomics-4443

C. ext Book(s)

1. Brown TA. Genomes, John Wiley & sons (Asia) Pvt. Ltd, Singapore, 2002.
2. DovStekal, Microarray Bioinformatics, Cambridge University Press, Cambridge. 2003.
3. Liebler, Introduction to Proteomics, Tools For new biology, Humana Press, New Jersey. 200l
4. Noor Ahmad Shaik, Khalid Rehman Hakeem, BabajanBanaganapalli, RamuElango, Essentials of Bioinformatics (Volume I) Understanding Bioinformatics Genes to Proteins.2019.

D. Reference Book(s)

1. Charles R. Cantor, Cassandra L. smith, genomics the science and technology behind the human genome project, John Wiley & SONS (Asia) Pvt. Ltd. Singapore, l999.
2. Primrose and Twyman. principles of genome analysis. Blackwell publishing, Oxford. 2003.
3. Gibsona and Muse, A primer of genome science. Sinauer Associates Inc. publisher, Sunderlands, New York. 2003.
4. Richard P. Simpson, proteins and proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York. 2004.
5. Reiner Westermeier, Tom Naven, proteomics in practice. Wiley-VCH, Weinheim. 2002.
6. Permington S and MJ Dun, proteomics from protein sequence to Function. Bios. Scientific Pub.Ltd. Oxford. 2002.

7. Philip E. Bourne, Helgeweissig., Structural Bioinfomatics. John wiley& Sons (Asia), Singapore. 2003.

E. Weblinks

1. https://nptel.ac.in/courses/102/103/102103017/
2. https://nptel.ac.in/courses/102/101/102101072/
3. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-bt26/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Basics of Genomics**		
1.1	Genome sequencing	Compare the Chain termination DNA sequencing with Chemical degradation sequencing	K2
		Employ the use of Pyrosequencing for rapid determination of very short sequences	K3
1.2	Assembly of a Contiguous DNA Sequence	Define sequence assembly and list the methods used for Sequence assembly	K1
1.3	The Human Genome Project	Discuss the future prospects of human genome project	K2
1.4	Understanding a Genome sequence	Identify the Location of the genes in a Genome Sequence	K2
2	**Mapping Genomes-Genetic and Physical Maps**		
2.1	Genetic Mapping	Describe the role of DNA markers, linkage and pedigree analysis in genetic mapping	K2
2.2	Physical Mapping	Interpret physical mapping with the help of Restriction mapping	K2
3	**Genome Anatomies**		
3.1	Eukaryotic Nuclear Genomes	Summarize the Genetic Features of Eukaryotic Nuclear Genomes	K2
		Analyze the human gene catalog	K4
		Identify the repetitive DNA content in eukaryotic nuclear genomes	K2
3.2	Techniques in Functional Genomics	Describe the role of Microarray Technology in Expression Analysis	K2
		Recall the Tools and Databases used in microarray technology	K1
4	**Basics of Proteomics**		
4.1	Proteomics and its techniques	Discuss the emerging trends in proteomics.	K2
		Categorize the tools used in proteomics	K4
		Distinguish between protein separation and protein digestion	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4.2	Mass Spectrometer for Protein and Peptide Analysis	Analyze the significance of mass spectrometer in Protein and Peptide Analysis	K4
5	**Proteomics databases and its applications**		
5.1	Mining Proteomes	Review the Protein identification tools – Muscot – PeptIdent – Protein prospector – GFS.	K6
5.2	Application of proteomics	Report the applications of proteomics in medicine, toxicology and pharmaceuticals.	K6

4. Mapping Scheme

I23BI915	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	L	L	-	-	M	L	H	M	M	M
CO2	H	M	M	L	L	-	L	M	L	H	M	M	M
CO3	H	M	M	L	L	-	-	M	L	H	M	M	M
CO4	H	M	M	L	L	-	L	M	L	H	M	M	M
CO5	H	M	M	L	L	-	L	M	L	H	M	M	M
CO6	H	M	M	L	L	-	L	M	L	H	M	H	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book Open Book Test.
2. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
3. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. K. Akila

Core XVI : Advances in Structural Bioinformatics

Semester : IX **Course Code I23BI916**

Credits : 5 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Recall the structure prediction and assessment methods	K1	I
CO2	Employ scoring functions to predict protein structure	K4	II
CO3	Summarize various binding site predicting servers	K2	III
CO4	Demonstrate the mechanism of ion channels using computational servers	K3	IV
CO5	Design an antibody with high affinity using computational methods	K5	IV
CO6	Analyze the structure based computational approaches in pharmacology	K4	V

2. A. Syllabus

Unit I - Structure Prediction and Assessment Methods-I **15 Hours**

1.1. Protein Structure Modeling: Introduction

1.2. Modeling Methods: Comparative protein structure modeling techniques, Accuracy and Limitations, De novo Modeling Techniques

1.3. Protein Modeling and Structural Genomics, Integrative (Hybrid) Modeling Techniques

1.4. Assessment and Evaluation of Prediction Accuracy

1.5. Protein Fold Recognition and Threading: Introduction

1.6. Fold Recognition: Sequence-based and Structure-Based

1.7. Hybrid Methods – Fully automated, Meta-Servers

1.8. Critical Assessment Methods: CASP, CAFASP, Livebench and EVA

Unit II - Structure Prediction and Assessment Methods-II **15 Hours**

2.1. Scoring Functions for Protein Structure Prediction: Introduction

2.2. Structure and Components of Scoring Functions

2.3. Assessment of Protein Structure Predictions

2.4. The Biological Applications of Protein Models

Unit III - From Structure to Function-I **15 Hours**

3.1. Classification of Protein Structures,
3.2. Methods to Characterize the Structure of Enzyme Binding Sites
3.3. Atomistic Simulations of Reactions and Transition States

Unit IV - From Structure to Function-II **15 Hours**

4.1. Functional Motions in Biomolecules: Insights from Computational Studies at Multiple Scales
4.2. Modeling and Simulation of Ion Channels
4.3. Computational Protein Design
4.4. Computational Antibody Engineering,

Unit V - Drug Discovery and Pharmacology **15 Hours**

5.1. Molecular Dynamics-based Free Energy Calculations
5.2. Structure-based Computational Pharmacology and Toxicology,
5.3. Structure-based Computational Approaches to Drug Metabolism

B. Topics for Self Study:

S.No	Topics	References/Weblink
1	Computers in Medicinal chemistry	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
2	Drug Discovery: Finding a Lead	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
3	Drug Design: Optimizing target interactions	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
4	Drug Design: Optimizing access to the target	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.
5	Getting the drug to market	Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press 2013.

C. **Text Book(s)**

1. Torsten Schwede, Manuel Peitsch, Computational Structural Biology: Methods and Applications, World Scientific, 2008.

D. **Reference Book(s)**

1. Phillip E. Brurne, HelgeWeissig, Structural Bioinformatics,A John Wiely& Sons Publications, 2011.

2. David M, Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory, 2004.
3. Rastogi RS, Bioinformatics: Concepts, Skills & Applications, Eastern Economy Edition 2008.
4. Thomas Hamelrcyck, Mardia KV, Bayesian methods in Structural Bioinformatics, Springer 2012.
5. Andrew Leach, Molecular modeling: Principles and Applications (2nd Edition),Addison Wesley Longman, Essex, England, 1996.
6. Frenkel D and Smith B, Understanding Molecular Simulations. From Algorithms to Applications, Academic Press, samdiego, California, 1996.
7. McCammon JA and Harvey SC. Dynamics of Proteins and Nucleic Acids. Cambridge University Press, Cambridge,1987.

E. Weblinks

1. https://nptel.ac.in/courses/102/107/102107086/
2. https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
3. https://onlinecourses.nptel.ac.in/noc20_bt23/preview

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	Structure Prediction and Assessment Methods-I		
1.1	Protein Structure Modeling: Introduction	Recall the basics of protein structure modeling	K1
1.2	Modeling Methods: Comparative protein structure modeling techniques, Accuracy and Limitations, De novo Modeling Techniques	Explain the steps and limitations involved in comparative protein structure modeling	K2
1.3	Protein Modeling and Structural Genomics, Integrative (Hybrid) Modeling Techniques	Describe the integrative modeling technique	K2
1.4 1.5	Assessment and Evaluation of Prediction Accuracy	Measure and analyze the protein structure accuracy	K4
1.6 1.7 1.8	Protein Fold Recognition and Threading: Introduction Fold Recognition: Sequence-based and Structure-Based Hybrid Methods – Fully automated, Meta-Servers Critical Assessment Methods: CASP, CAFASP, Livebench and EVA	Explain the various methods in fold recognition	K2

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2	**Structure Prediction and Assessment Methods-II**		
2.1	Scoring Functions for Protein Structure Prediction: Introduction	List the types of scoring functions	K1
2.2	Structure and Components of Scoring Functions	Describe the Structure and Components of Scoring Functions	K2
2.3	Assessment of Protein Structure Predictions	Explain the steps involved in Assessment of Protein Structure Predictions	K2
2.4	The Biological Applications of Protein Models	Debate the Biological Applications of Protein Models	K4
3	**From Structure to Function-I**		
3.1	Classification of Protein Structures	Tell the classification of Proteins	K2
3.2	Methods to Characterize the Structure of Enzyme Binding Sites	Explain the Characteristics of the Structure of Enzyme Binding Sites	K2
3.3	Atomistic Simulations of Reactions and Transition States	Define Atomistic Simulations	K1
4	**From Structure to Function-II**		
4.1 4.2	Functional Motions in Biomolecules: Insights from Computational Studies at Multiple Scales Modeling and Simulation of Ion Channels	Demonstrate the mechanism of ion channels using computational servers	K3
4.3 4.4	Computational Protein Design Computational Antibody Engineering	Design an antibody with high affinity using computational methods	K5
5	**Unit – V: Drug Discovery and Pharmacology**		
5.1	Molecular Dynamics-based Free Energy Calculations	Discuss the Molecular Dynamics based Free Energy Calculations	K2
5.2	Structure-based Computational Pharmacology and Toxicology	Compare computational based pharmacology with toxicology	K2
5.3	Structure-based Computational Approaches to Drug Metabolism	Critique the structure based computational approaches in drug metabolism	K4

4. **Mapping Scheme**

I23BI916	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	L	-	L	-	L	M	L	H	M	M	H
CO2	M	M	L	-	L	-	L	M	L	H	M	M	H
CO3	M	M	L	-	L	-	L	M	L	H	M	M	H
CO4	M	M	L	-	L	-	L	M	L	H	M	M	H
CO5	M	M	L	M	L	L	L	M	L	H	M	M	H
CO6	M	M	L	M	L	-	L	M	L	H	M	M	H

L: Low **M: Medium** **H: High**

5. **Course Assessment Methods**

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Core XVII : Advanced Programming in Python

Semester : IX **Course Code : I23BI917**

Credits : 4 **Hours/Week : 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Outline the basic concepts of web applications and webservices	K2	I
CO2	Organize the applications with version control and utilise github	K3	II
CO3	Develop web applications with routing	K6	III
CO4	Build web applications with session management	K6	IV
CO5	Design web application with backend	K6	IV
CO6	Develop web applications using various Python libraries	K6	V

2. A. Syllabus

Unit – I – Web application and webservices basics with tools and technologies used **15 Hours**

1.1 Definition-Distributed system
1.2 Available Frontends and Backends to develop web applications
1.3 Various IDE configurations-
1.4 Multitiered architecture
1.5 HTTP request and response
1.6 HTTP methods
1.7 Webservices: SOAP basics
1.8 REST API-SOAP Vs REST API-
1.9 Tools and Technologies- IDEs –STS(Eclipse)

Unit – II – Version Control and git commands **15 Hours**

2.1 What is version control
2.2 Github
2.3 bitbucket
2.4 git commands:push,pull,merge,clone

2.5 cloud repositories
2.6 Open source Python package manager - PIP | requirements.txt

Unit -III- Environment setting and routing **15 Hours**

3.1 Setting up the environment
3.2 Routing
3.3 URL building
3.4 Templates
3.5 Static Files
3.6 Request Object
3.7 Sending form data to template

Unit - IV – Session Management **15 Hours**

4.1 Session Management : Cookies
4.2 Sessions
4.3 Redirect and errors
4.4 Message flashing
4.5 file uploading
4.6 Extensions
4.7 Mail - WTF | SQLAlchemy –
4.8 Connecting to the DB -Create - Read - Update - Delete (CRUD)

Unit – V – Open source Python libraries **15 Hours**

5.1 Python Libraries
5.2 Numpy
5.3 Pandas
5.4 Tensorflow
5.5 PyTorch
5.6 OpenCV
5.7 ApacheSpark
5.8 fastText

B. Topics for Self Study:

S.No	Topics	Web links
1	Django Framework	https://docs.djangoproject.com/en/4.0/
2	Data science in Python	https://bioinfotraining.bio.cam.ac.uk/postgraduate/programming/bioinfo-dspyt

S.No	Topics	Web links
3	Machine Learning for drug discovery	https://www.freecodecamp.org/news/python-for-bioinformatics-use-machine-learning-and-data-analysis-for-drug-discovery/
4	RESTful Web Service	https://docs.oracle.com/javaee/6/tutorial/doc/gijqy.html

C. Text Book(s)

1. Miguel Grinberg, Flask Web Development Developing Web Applications with Python (2nd Edition), O'Reilly Media, 2018.

D. Reference Book(s)

1. Web Development with Python Flask,Frank Anemaet,Leanpub,2022
2. Python Flask for Beginners, Learn Web Development with Flask, Alejandro Garcia,Leanpub,2020

E. Weblinks

1. https://www.fullstackpython.com/
2. https://www.digitalocean.com/community/tutorials/build-a-crud-web-app-with-python-and-flask-part-one
3. https://blog.miguelgrinberg.com/
4. https://flask.palletsprojects.com/en/2.1.x/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Web application and webservices basics with tools and technologies used**		
1.1	Definition-Distributed system	Recall distributed system with examples	K1
1.2	Available Frontends and Backends to develop web applications	Classify the tools and technologies used in web applications	K2
1.3	Various IDE configurations-	Select appropriate IDE's for developing web applications	K3
1.4	Multitiered architecture	Distinguish various tiered architectures	K4
1.5	HTTP request and response	Experiment with request and response objects in a web applications	K3
1.6	HTTP methods	Summarize all the HTTP methods available	K2
1.7	Webservices: SOAP basics	Tell what is a webservice	K1
1.8	REST API-SOAP Vs REST API	Compare the advantages of REST API with SOAP	K4

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1.9	Tools and Technologies- IDEs – STS(Eclipse)	Make use of STS IDE to develop applications	K3
2	**Version Control and git commands**		
2.1	What is version control	Apply version control while enhancing applications	K3
2.2	Github	Organize coding in github	K3
2.3	Bitbucket	Improve code maintenance using bitbucket	K6
2.4	git commands: push,pull,merge, clone	Apply git commands to upload	K3
2.5	cloud repositories	Maximize the use of cloud repositories for applications	K6
2.6	Open source Python package manager - PIP | requirements.txt	Build applications using Python packages	K6
3	**Environment setting and routing**		
3.1	Setting up the environment	Test for environment setting	K4
3.2	Routing	Combine routing with request and response objects	K6
3.3	URL building	Apply url building	K3
3.4	Templates	Develop applications using templates	K6
3.5	Static Files	Compile web application with static files in flask	K6
3.6	Request Object	Examine request object	K4
3.7	Sending form data to template	Develop a web application with data passing	K6
4	**Session Management**		
4.1	Session Management : Cookies	Improve applications with session management by sending cookies	K6
4.2	Sessions	Combine session handling in applications	K6
4.3	Redirect and errors	Design applications with page navigation	K6
4.4	Message flashing	Adapt flashing of message in applications	K6
4.5	file uploading	Modify applications with file upload feature	K6
4.6	Extensions	Improve applications by adding extensions	K6
4.7	Mail - WTF | SQLAlchemy	Develop applications with mail sending feature	K6
4.8	Connecting to the DB -Create - Read - Update - Delete (CRUD)	Create web application by embedding database in int	K6
5	**Open source Python libraries**		
5.1	Python Libraries	Classify various Python libraries based on the applications	K4
5.2	Numpy	Utilise Numpy library for mathematical related applications	K3
5.3	Pandas	Build data analytical applications with Pandas	K6

Unit/ Section	Course Content	Learning Outcomes	HBTLT
5.4	Tensorflow	Create deeplearning applications by using Tensorflow	K6
5.5	PyTorch	Design prototypes using PyTorch library	K6
5.6	OpenCV	Develop AI applications using OpenCV libraries	K6
5.7	ApacheSpark	Maximize the use of Machine Learning libraries	K6
5.8	fastText	Build applications with fastText library for supervised and unsupervised learnings	K6

4. Mapping Scheme

I20BI710	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. T. Cynthia

Core Prac IX : Advances in Structural Bioinformatics Lab

Semester : IX **Course Code I23BIP12**

Credits : 3 **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Experiment
CO1	Design small molecules and prepare them in proper file format	K5	6, 8
CO2	Perform docking in advance docking tools and Interpret the post-docking results	K3	11, 12
CO3	Analyse the biological properties of small molecules	K4	4, 5, 9
CO4	Build and measure the energy of macromolecules using quantum mechanics	K5	7, 9
CO5	Justify the pharmacophore models developed by small molecules	K6	10
CO6	Classify the given proteins through sequence and structure comparison	K5	1, 2, 3

2. A. List of Experiments

1. Genome annotation using GenSAS - Genome Sequence Annotation Server
2. Biological Sequence Alignment Editor –BioEdit
3. Protein Structure Comparison – DALI Server
4. Molecular Force Field analysis by TINKER Software
5. Calculation of Molecular Properties and Drug-likeness by Molinspiration.
6. Model building of organic molecules using the ChemSketch, CHEMDRAW.
7. Three dimensional structure prediction by using MODELLER.
8. Chemical structure retrieval from Zinc and NCI database.
9. Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab).
10. Pharmacophore Tool For Virtual Screening - Pharmer
11. Molecular Docking of protein and ligand by AUTODOCK and AutoDockVina
12. Protein-Protein Docking : ClusPro 2.0

B. Topics for Self Study

S.No	Topics	Web Link
1	Molecular Mechanics-Force Field	https://youtu.be/gP6HfBQ_LkI
2	Pahrmacophore modeling	https://youtu.be/wZd-oNpzNTc
3	Target based drug design	https://youtu.be/qWAiowXvko0

C. Reference Book(s)

1. Gautham N, Bioinformatics Database and Algorithms, Narosa publishing House. 2009.
2. Baxevanis, A.D. and Francis Ouellellette B.F, Bioinformatics –a Practical Guide to the Analysis of Genes and Proteins , Wiley India Pvt Ltd .2009.
3. Teresa K. Attwood, David J. Parry-Smith. Introduction to bioinformatics, Pearson Education,1999.

D. Weblinks

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://onlinecourses.nptel.ac.in/noc21_cs67/preview
3. https://nptel.ac.in/courses/106/106/106106212/

3. Specific Learning Outcomes (SLO)

Ex. No	Course Contents	Learning Outcomes	HBTLT
1	Genome annotation using GenSAS - Genome Sequence Annotation Server	Inspect the annotated genome results	K4
2	Biological Sequence Alignment Editor – BioEdit	Interpret the different types of alignment based o different algorithms	K6
3	Protein Structure Comparison – DALI Server	assess the comparative study of proteins based on their results	K6
4	Molecular Force Field analysis by TINKER Software	Evaluate the energy minimized models	K6
5	Calculation of Molecular Properties and Drug-likeness by Molinspiration	Choose the better small molecules for docking studies	K6
6	Model building of organic molecules using the ChemSketch, CHEMDRAW	Create and design novel small molecule structures	K5
7	Three dimensional structure prediction by using MODELLER	Build novel macromolecular structures from sequence	K5
8	Chemical structure retrieval from Zinc and NCI database	Perform proper steps to retrieve desired library of small molecules	K3

Ex. No	Course Contents	Learning Outcomes	HBTLT
9	Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab)	Evaluate the small molecules by calculating their energies	K6
10	Pharmacophore Tool For Virtual Screening - Pharmer	Construct novel pharmacophore model for virtual screening	K5
11	Molecular Docking of protein and ligand by AUTODOCK and AutoDockVina	Justify the potential molecule based on score	K6
12	Protein-Protein Docking : ClusPro 2.0	Interpret the interactions of proteins based on their docked scores and docked residues	K6

4. Mapping Scheme

I23BIP12	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	M	-	H	M	-	H	H	M	H
CO2	H	H	L	L	L	L	L	-	-	H	H	L	-
CO3	H	H	L	L	L	-	-	-	-	M	-	-	M
CO4	H	H	-	-	M	L	-	-	-	H	-	-	M
CO5	H	H	H	L	M	-	-	-	L	M	-	L	L
CO6	H	H	M	M	M	L	M	H	-	H	L	L	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Core Prac XIII : Advanced Programming in Python Lab

Semester : IX **Course Code : I22BIP13**

Credits : 3 **Hours / Week : 5**

1. Course Outcomes

After completing the course, the students able to

CO. No	Course Outcomes	Level	Experiment
CO1	Build applications with database integration	K6	1
CO2	Design web applications with version control	K6	2
CO3	Develop applications using IDE and UI	K6	3
CO4	Create applications by embedding business logics	K6	4
CO5	Combine data science with Python programming	K6	5
CO6	Adapt Python programming for bioinformatics	K6	5

2. A. List of Experiments

Ex. No.	Exercise
1	Write a Python program to develop a crud-operated application for student attendance
2	Write a Python program to develop a Portfolio for yourself and push the code to git.
3	Write a Python program to develop a simple blog app
4	Write a Python function to develop currency convertor web application
5	Write a Python function to Expose endpoints to do fast alignment,sequencing, ATGC conversions

B. Topics for Self Study

S.No	Topics	Web Link
1	Version control of a Python project using Git	https://www.coursera.org/projects/version-control-of-a-python-project-using-git
2	Flask CRUD Application – Create, Retrieve, Update, and Delete	https://www.askpython.com/python-modules/flask/flask-crud-application
3	Create CRUD API in Flask	https://www.section.io/engineering-education/flask-crud-api/
4	Flask vs Django	https://testdriven.io/blog/django-vs-flask/

C. Reference Book(s)

1. Web Development with Python Flask,Frank Anemaet,Leanpub,2022
2. Python Flask for Beginners, Learn Web Development with Flask, Alejandro Garcia,Leanpub,2020
3. Mastering Flask Web Development, Daniel Gaspar, Jack Stouffer, second edition, Packt,2018

D. Weblinks

1. https://www.youtube.com/watch?v=Z1RJmh_OqeA
2. https://flask.palletsprojects.com/en/2.1.x/
3. https://www.udemy.com/course/flask-framework-complete-course- for-beginners/

3. Specific Learning Outcomes (SLO)

Ex. No.	Course Contents	Learning Outcomes	HBTLT
1	Write a Python program to develop a crud-operated application for student attendance	Combine frontend and backend	K6
2	Write a Python program to Develop a Portfolio for yourself and push the code to git.	Build applications with version controls	K6
3	Write a Python program to Develop a simple blog app	Create web applications with UX	K6
4	Write a Python function to Develop currency convertor web application	Design applications with business logics	K6
5	Write a Python function to Expose endpoints to do fast alignment,sequencing, ATGC conversions	Adapt Python with bioinformatics	K6

4. Mapping Scheme

I20BIP13	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	H	L	-	M	M	H	H	-	M
CO2	M	H	M	H	M	M	-	M	M	H	H	-	L
CO3	H	H	M	H	H	H	L	M	L	H	H	L	H
CO4	H	H	M	H	H	H	L	M	M	H	H	-	H
CO5	H	H	M	H	H	H	L	M	M	H	H	-	H
CO6	H	H	M	H	H	H	L	M	L	H	H	H	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Practical Components): Closed Book
2. Cooperative Learning Report, Assignment, Group Discussion, project Report, Field Visit Report, Seminar.
3. Pre/Post Test, Viva, Report for each Exercise.
4. Lab Model Examination & End Semester Practical Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator : **Dr. T. Cynthia**

Elective VII : Cheminformatics

Semester : IX **Course Code :I23BI9:A**

Credits : 4 **Hours/Week : 4**

1. Course Outcomes

After completion of this course student would be able to

CO. No	Course Outcomes	Level	Unit
CO1	Practice the skills to analyse the properties of small molecules and explain the manipulation of 2D molecular structures	K3	I
CO2	Design the different formats and methods of chemical compound representation	K5	II
CO3	Demonstrate the various molecular notations to represent the chemical structure	K3	II
CO4	Analyze the various cheminformatics databases	K4	III
CO5	Assess the structure similarity search of chemical structures	K6	IV
CO6	Build the knowledge of High-Throughput Screening by using the concepts of QSAR to create novel leads	K5	V

2. A. Syllabus

Unit I –Introduction to Cheminformatics **15 Hours**

1.1 Introduction to Cheminformatics, Scope of Cheminformatics, History and Evolution of Cheminformatics.

1.2 Structure Databases: Chemical Structure Databases (PubChem,ChemSpider Drug bank,)

1.3 Modelling of small molecules and Structure Elucidation

Unit II - Representation of Molecules **15 Hours**

2.1 Representation of Molecules and Chemical Reactions –Computer representations of chemical structures-Graph theoretic representation of chemical structures.

2.2 Different Types of Notations, SMILES Coding, Structure of Mol files and Sdf files (Molecular converter, SMILES Translator),Connection table,Linear notations

2.3 Similarity Search of the Molecule (ChEMBL,Swiss similarity)

Unit III -Cheminformatics databases **15 Hours**

3.1 Structure databases; Reaction Databases; Literature Databases; Medline; GenBank

3.2 PIR; CAS Registry; National Cancer Institute (NCI) Database

3.3 Databases of Small Molecules (ZINC)

Unit IV - Searching Chemical Structures **15 Hours**

4.1 Searching Chemical Structure: Full Structure Search; Sub Structure Search; Similarity Search.

4.2 Molecular Descriptors-Introduction- Descriptors Calculated from the 2D Structure- Descriptors Based on 3D Representations- Data Verification and Manipulation.

4.3 Three dimensional Search Methods. Structure Visualization, Similarity Methods- Similarity Based on 2D Fingerprints- Similarity Coefficients- 2D Descriptor Methods- 3D Similarity- Selecting Diverse Sets Of Compounds.

Unit V - Applications of Cheminformatics tools **15 Hours**

5.1 Computational Models Introduction- deriving a QSAR Equation- Simple and Multiple Linear Regression- Designing a QSAR "Experiment"- Principal Components Regression- Partial Least Squares- Molecular Field Analysis and Partial Least Squares.

5.2 Analysis of High-Throughput Screening Data- Data Visualization- Data Mining Methods Virtual Screening-Drug-Likeness and Compound Filters

5.3 Structure-Based Virtual Screening- The Prediction of ADMET Properties

B. Topics for Self Study:

S.No	Topics	Web Links
1.	Artificial Intelligence for Chemical Reaction Predictions	https://www.youtube.com/watch?v=ff8t58hLxh4
2.	Drug discovery and medicinal chemistry	https://www.mooc-list.com/course/drug-discovery-medicinal-chemistry-edx
3.	Patents and generic drugs	https://www.mooc-list.com/course/drug-discovery-medicinal-chemistry-edx
4.	Drug development and product development	https://www.coursera.org/specializations/drug-development-product-management

C. Text Book(s)

1. Johann Gasteiger and Thomas Engel. Chemoinformatics -A Textbook. Germany: Wiley-VCH, 2003. Unit-1, 2 and 3

2. Johann Gasteiger. Handbook of Chemoinformatics-From Data to Knowledge, Germany: Wiley-VCH, 2003. Unit-1, 2 and 3

3. Andrew R. Leach, Valerie J. Gillet. An Introduction to Chemoinformatics.UK: Springer, 2007. Unit II - , 4 and 5.

D. Reference Book(s)

1. Jürgen Bajorath,Chemoinformatics: Concepts, Methods, and Tools for Drug Discovery, Humana press, 2004.
2. C.R.Cantor&P.R.Schimmel, Biophysical Chemistry Part - I, W.H. Freeman & Co., in San Fransisco, 1980.
3. R. Glaser, Biophysics, Springer, 2000. 5. Sterochemistry of Organic Compounds by Ernest. L.Elielet. al., John Wiley & Sons, 199
4. Sterochemistry – Conformation & Mechanism by P.S.Kalsi, New Age International Ltd., 1990.

E. Weblinks

1. https://nptel.ac.in/courses/104/101/104101095/
2. https://www.mooc-list.com/course/drug-discovery-medicinal-chemistry-edx
3. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-bt28/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction**		
1.1	Introduction to Cheminformatics, History and Evolution of Cheminformatics, Use of Cheminformatics, Prospects of Cheminformatics	Recall the basic concepts of cheminformatics Discuss the need for cheminformatics in drug discovery	K1 K2
1.2	Structure Databases: Chemical Structure Databases (PubChem,ChemSpider Drug bank,)	Explain the different structure databases and its advantages	K2
1.3	Modelling of small molecules and Structure Elucidation	Practice the types of molecular modelling and structure elucidation tools and softwares	K3
2	**Representation of Molecules**		
2.1	Representation of Molecules and Chemical Reactions –Computer representations of chemical structures-Graph theoretic representation of chemical structures.	Explain the different ways of representing of chemical structures	K2
2.2	Different Types of Notations, SMILES Coding, Structure of Mol files and Sdf files (Molecular converter, SMILES Translator),Connection table,Linear notations	Use different types of notations to represent the small molecules	K3

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2.3	Similarity Search of the Molecule (ChEMBL,Swiss similarity)	Integrate the role of ChEMBL,Swiss similarity in structure similarity search	K5
3	**Cheminformatics databases**		
3.1	Structure databases; Reaction Databases; Literature Databases; Medline; GenBank	Recognize the different types of cheminformatics databases available online	K1
3.2	PIR; CAS Registry; National Cancer Institute (NCI) Database	Use the specific PIR,CAS,NCI databases for retrieving the chemical information	K3
3.3	Databases of Small Molecules (ZINC)	Analyze the small molecule database ZINC to perform Virtual screening	K4
4	**Searching Chemical Structures**		
4.1	Searching Chemical Structure: Full Structure Search; Sub Structure Search; Similarity Search.	Use structure and substructure searchin the small molecule database to identify similar molecules	K3
4.2	Molecular Descriptors-Introduction-Descriptors Calculated from the 2D Structure-Descriptors Based on 3D Representations-Data Verification and Manipulation.	Calculate the molecular descriptors in the compounds to find its properties	K4
4.3	Three dimensional Search Methods. Structure Visualization, Similarity Methods- Similarity Based on 2D Fingerprints- Similarity Coefficients- 2D Descriptor Methods- 3D Similarity- Selecting Diverse Sets Of Compounds.	Evaluate the various three dimensional methods to select diverse compounds	K6
5	**Applications of Cheminformatics tools**		
5.1	Computational Models Introduction- deriving a QSAR Equation- Simple and Multiple Linear Regression- Designing a QSAR "Experiment"-Principal Components Regression- Partial Least Squares- Molecular Field Analysis and Partial Least Squares.	Design new computational models to find the structure activity relationship of the compounds	K5
5.2	Analysis of High-Throughput Screening Data-Data Visualization- Data Mining Methods-Virtual Screening-Drug-Likeness and Compound Filters	Analyze the drug likeness of the chemical structures using High-Throughput Screening methods and visualization techniques	K4
5.3	Structure-Based Virtual Screening- The Prediction of ADMET Properties	Integrate the physiochemical and biochemical properties of the screened chemical structures	K5

4. Mapping Scheme

I23BI9:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	H	M	L	-	L	L	H	H	M	H
CO2	H	L	L	M	L	L	-	L	L	M	H	H	H
CO3	H	L	L	M	L	-	-	L	L	M	H	H	H
CO4	M	M	M	M	M	-	-	L	M	H	H	H	H
CO5	H	M	M	H	M	L	-	L	L	H	H	M	H
CO6	H	M	M	H	M	L	-	L	L	H	H	M	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

Elec VII : Data Mining and Designing

Semester : IX **Course Code : I23BI9:B**

Credits : 4 **Hours/Week : 4**

1. Course Outcomes

After completing the course, the students able to

CO. No	Course Outcomes	Level	Unit
CO1	State the basic concepts of data mining principles and techniques	K1	I
CO2	Explain the ideas behind the data design and representation	K2	II
CO3	Construct data mining techniques with various algorithms	K3	III
CO4	Differentiate database system from file system by enumerating the features provide by database system	K4	IV
CO5	Create quantitative analysis report/memo with the necessary information to make decisions	K5	IV
CO6	Build data models to create relational and transactional databases.	K5	V

2. A. Syllabus

Unit I - Basics of data mining **15 Hours**

1.1 Basics of data mining, related concepts,

1.2 Data mining techniques. Data Mining Algorithms: Classification, Clustering, Association rules.

1.3 Knowledge Discovery: KDD Process.

1.4 Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining.

Unit II - Information Access and Delivery **15 Hours**

2.1 Information Access and Delivery: Matching information to classes of users, OLAP in data warehouse, Data warehousing and the web.

2.2 Implementation and Maintenance: Physical design process, data warehouse deployment, growth and maintenance.

Unit III - Data Design And Data Representation **15 Hours**

3.1 Data Design And Data Representation: Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading, data quality.

3.2 Basic elements of data warehousing, Planning and Requirements: Project planning and management, Collecting the requirements.

3.3 Architecture And Infrastructure: Architectural components, Infrastructure and metadata.

Unit IV - Advanced Topics **15 Hours**

4.1 Advanced Topics: Spatial mining, temporal mining.

4.2 Visualization Data generalization and summarization-based characterization, Analytical characterization: analysis of attribute relevance, Mining class comparisons:

4.3 Discriminating between different classes,

4.4 Mining descriptive statistical measures in large databases Data Mining Primitives, Languages.

Unit V - System Architectures **15 Hours**

5.1 System Architectures: Data mining primitives, Query language, Designing GUI based on a data mining query language.

5.2 Data Abstraction; Data Models; Instances & Schemes; E-R Model - Entity and entity sets; Relations and relationship sets; E-R diagrams; Reducing E-R Diagrams to tables.

5.3 Network Data Model: Basic concepts; Hierarchical Data Model: Basic Concepts;

5.4 Multimedia Databases - Basic Concepts and Applications; Indexing and Hashing.

B. Topics for Self Study:

S.No	Topics	Web Links
1.	Data mining in Bioinformatics	http://www.bioinformaticszen.com/post/an-introduction-to-data-mining-in-bioinformatics/
2.	Biological data mining and its applications in healthcare	https://www.worldscientific.com/doi/pdf/10.1142/9789814551014_fmatter
3..	Data mining analysis in Genomics and Proteomics	Journal of Data Mining in Genomics & Proteomics
4.	Text Mining and its Biomedical Applications	Olivierocarugo and Frank Eisenhaber. Data Ming techniques for life sciences. Singapore:Humana Press, 2009.

C. Text Book

1. Witten, I.H. and Frank, E. “Data mining: Practical Machine Learning Tools and Techniques”, Morgan Kauffman Publishers, USA. 2005.

D. Reference Book(s)

1. Gajendra Sharma, S. K. Kataria& Sons, Data Mining Data Warehousing and Olap – 2009
2. Nagabhushana, S, Data Warehousing Olap And Data Mining, New Age International, 2006
3. Michael W. Hawkins, Michelle C, Data Warehousing: Architecture and Implementation,1999.

E. Weblinks

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview
3. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Basics of data mining**		
1.1	Basics of data mining, related concepts, Data mining techniques.	Define data mining	K1
1.2	Data Mining Algorithms: Classification, Clustering, Association rules.	Discuss the Data Mining Algorithms	K2
1.3	Knowledge Discovery: KDD Process.	Explain the KDD Process	K2
1.4	Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining.	Summarize the Web Content Mining, Web Structure Mining, Web Usage mining by design.	K2
2	**Information Access and Delivery**		
2.1	Information Access and Delivery: Matching information to classes of users, OLAP in data warehouse, Data warehousing and the web.	Discuss the OLAP in data warehouse, Data warehousing and the web.	K2
2.2	Implementation and Maintenance: Physical design process, data warehouse deployment, growth and maintenance.	Analyse the Physical design process, data warehouse deployment, growth and maintenance.	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
3	**Data Design And Data Representation**		
3.1	Data Design And Data Representation: Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading, data quality.	Analyse the Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading	K4
3.2	Basic elements of data warehousing, Planning and Requirements: Project planning and management, Collecting the requirements.	Explain the Project planning and management, Collecting the requirements	K2
3.3	Architecture And Infrastructure: Architectural components, Infrastructure and metadata.	Discuss the Architectural components, Infrastructure and metadata.	K2
4	**Advanced Topics**		
4.1	Advanced Topics: Spatial mining, temporal mining	Discuss the Spatial mining, temporal mining	K2
4.2	Visualization Data generalization and summarization-based characterization,	Define theVisualization Data generalization and summarization-based characterization	K1
4.3	Analytical characterization: analysis of attribute relevance,	Explain the concept of attribute relevance	K2
4.4	Mining class comparisons: Discriminating between different classes, Mining descriptive statistical measures in large databases Data Mining Primitives, Languages.	Analyze the differences in classes, Mining descriptive statistical measures in large databases Data Mining Primitives, Languages.	K4
5	**System Architectures**		
5.1	System Architectures: Data mining primitives, Query language, Designing GUI based on a data mining query language.	Use Query language for designing GUI based data	K3
5.2	Data Abstraction; Data Models; Instances & Schemes; E-R Model - Entity and entity sets; Relations and relationship sets; E-R diagrams; Reducing E-R Diagrams to tables.	Demonstrate the E-R Model - Entity and entity sets; Relations and relationship sets; E-R diagrams; Reducing E-R Diagrams to tables.	K3
5.3	Network Data Model: Basic concepts; Hierarchical Data Model: Basic Concepts;	Build data models to create relational and transactional databases.	K5
5.4	Multimedia Databases - Basic Concepts and Applications; Indexing and Hashing.	Analyze the Basic Concepts and Applications of Indexing and Hashing.	K4

4. **Mapping Scheme**

I23BI9:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	M	L	L	L	-	M	M	M	M	M	L
CO2	M	-	M	-	L	-	-	M	-	-	-	-	-
CO3	M	-	M	L	-	-	-	M	M	-	-	M	L
CO4	M	L	M	L	L	L	-	M	M	M	M	M	L
CO5	M	-	M	L	-		-	M	-	-	-	-	L
CO6	M	-	M	L	-		-	M	-	L	M	-	L

L: Low **M: Medium** **H: High**

5. **Course Assessment Methods**

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Mrs. A. Sherlin Rosita

GC : Scientific Writing and Research Publication Ethics

Semester : IX **Course Code :I23BI9E2**

Credits : 1 **Hours/Week : 1**

COURSE OUTCOMES

On Completion of the Course, the students will be able to:

Sl. No	Course Outcomes	Level	Unit
1	Describe the fundamentals of Scientific writing	K1	I
2	Identify the different resources & search engines in research	K2	II
3	Explain the concept of Plagiarism and the consequences of violating plagiarism.	K3	III
4	Identify and make use of various software tools	K2	IV
5	Identify the quality journals from the appropriate data base according to their field of interest	K3	IV
6	Evaluate the quality of journals based on various Bibliometrics	K4	V

Unit I: Fundamentals of Scientific Writing : Introduction to different kinds of publications, specialized journals in Biotechnology and Bioinformatics; Types of papers- Short communications, Research articles, Review articles, Systematic Review and Meta-analysis. Barriers to Scientific writing, Grammarly, Paraphrasing tools

Unit II : Literature Review -Article finding : Conducting article search using search tools/resources-UGC care, Google scholar, PubMed, Cochrane database, Science direct, ProQuest, Embase, Web of Science, ERIC, DOAJ ,JSTOR, Biological Abstracts, BioOne, CINAHL ,Index Copernicus, Scopus. Referencing – EndNote, Mendeley

Unit III: Publication ethics: Plagiarism – concept and problem that leads to unethical behaviour – violation of publication ethics - predatory publishers and journals - redundant publications – overlapping publications

Unit IV: Open access publishing – initiatives – software tool to identify predatory publications - Journal finder – journal suggestions – journal suggestor-Publication misconduct – specific ethical issues – authorship – conflicts of interest – complaints and appeals - examples of fraud – use of plagiarism software – URKUND – TURNITIN.

Unit V: Databases and Research Metrics – Indexing databases – Citation databases: Web of Science, Scopus – Impact Factors of journal as per Journal Citation Report, SNIP, SJR, IPP. Cite Score – Metrics: h-index, g index, i10 index, altmetrics.

References

1. Bairagi, Vinayak, and Mousami V. Munot, eds. Research methodology: A practical and scientific approach. CRC Press, 2019.Guidelines for Safety Assessment of Foods Derived from Genetically Engineered Plants.2008.
2. Kothari, Chakravanti Rajagopalachari. Research methodology: Methods and techniques.New Age International, 2004.
3. Kuhse, H. (2010). Bioethics: An anthology. Malden, MA: Blackwell.Kumar, Ranjit. Research methodology: A step-by-step guide for beginners. Sage, 2018. National Biodiversity Authority. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry ofScience and Technology, Govt. of India. Richard, Pring. Philosophy of Educational Research. Continuum, 2000.
4. Surbhi Jain, Research Methodology in Arts, Science and Humanities. Society Publishing, 2019.
5. Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009). Problem formulation in the environmental risk assessment for geneticallymodified plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9

Core XVIII : Pharmacoinformatics

Semester : X **Course Code : I23BIX18**

Credits : 4 **Hours/Week : 5**

1. Course Outcomes

After completing the course, the students able to

CO. No	Course Outcomes	Level	Unit
CO1	Describe the principles of pharmacodynamics and pharmacokinetics	K1	I
CO2	Use the combinatorial chemistry strategies to solve the problems in drug development	K3	II
CO3	Classify the different pathways of drug metabolism	K2	III
CO4	Analyse the genetic differences between individuals and relating the pros and cons of drug therapy	K4	IV
CO5	Plan innovative strategies for the potential drug discovery	K5	IV
CO6	Evaluate the significance of pharmacovigilance and ADRS strategies in pharmacoinformatics	K6	V

2. A. Syllabus

Unit I -Introduction to Biopharmaceutics and Pharmacokinetics 15 Hours

1.1. Drug Product Performance, Biopharmaceutics,
1.2. Pharmacokinetics, Pharmacodynamics, Clinical Pharmacokinetics,
1.3. Practical focus, Pharmacodynamics, Drug exposure and Drug Response,
1.4. Toxiocokinetics and Clinical Toxicology,
1.5. Measurement of Drug Concentrations, Basic Pharmacokinetics and Pharmacokinetic Models

Unit II - Combinatorial Chemistry 15 Hours

2.1. Introduction, Drug-Like Molecules, Supports and links, Solution-Phase
2.2. Combinatorial Chemistry, Pooling Strategies, Detection, Purification and Analysis
2.3. Encoding Combinatorial Libraries, HTS, Virtual Screening,
2.4. Chemical Diversity and Library Design

Unit III - Metabolic Changes of Drugs and Related Organic Compounds
15 Hours

3.1. General Pathways of Drug Metabolism
3.2. Sites of Drug Biotransformation
3.3. Role of Cytochrome P-450 Monooxygenases in Oxidative Biotransformations
3.4. Phase II or Conjugation Reactions
3.5. Factors affecting Drug Metabolism

Unit IV - Prodrugs and Drug Latentiation **15 Hours**

4.1. History, Basic Concepts
4.2. Prodrugs of Functional Groups, BioprecursorProdrugs Chemical Delivery Systems.
4.3. Biotechnology and Drug Discovery – Novel Drug-Screening Strategies, Processing of the Recombinant Protein, Pharmaceutics of rDNA Produced Agents
4.4. Delivery and Pharmacokinetics of Biotechnology Products

Unit V - Pharmacovigilance **15 Hours**

5.1. Introduction, Definition and Terminologies
5.2. Predisposing Factors of ADRS, Importance, Surveillance Methods, Evolution of Individual ADRS
5.3. Roles of Various Professionals in Pharmacovigilance, International Regulatory Agencies on Pharmacovigilance and Influence of Pharmacoinformatics,
5.4. Pharmacoinformatics: Various Arenas, Future ofPharmacoinformaticsIn Improving Pharmacovigilance

B. Topics for Self Study:

S. No	Topics	Weblinks
1	PVB MDeC	https://www.youtube.com/watch?v=x8DJGRMpJGg
2	Combinatorial Chemistry	https://www.youtube.com/watch?v=MVgsX7PM4F4
3	Pharmacokinetics	https://www.youtube.com/watch?v=NKV5iaUVBUI
4	Pharmacovigilance	https://www.youtube.com/watch?v=N2EKE1oZjn8

C. Text Book(s)

1. John. H. Block, Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams & Wilkins, 2004
2. Shargel& Yu, Applied Biopharmaceutics and Pharmacokinetics, McGraw Hill, 2012

D. Reference Book(s)

1. Block J.H. and Beale Jr.J.M.. Organic medicinal and Pharmaceutical chemistry. Lippincott Williams and Wilkins, New York. 2004
2. Patwaradhan.B.. Drug discovery and development. New India publishing agency, New Delhi. 2007
3. ShargelL. and Yu. A.B.C. Applied Biopharmaceutics and Pharmacology. McGraw-Hill, New York. 1999
4. BrownD.M.. Drug delivery systems in Cancer therapy. Humana press, Totowa, New Jersey. 2004.
5. Rothstein, Pharmacogenomics: Social, ethical and clinical dimensions, Wiley Less. 2005
6. Jin Xiong. Essential Bioinformatics. Cambridge University Press. 2000

E. Weblinks

1. https://nptel.ac.in/courses/102/108/102108077/
2. https://www.digimat.in/nptel/courses/medical/pharmacology/PH11.html
3. https://dth.ac.in/medical/courses/pharmacology/3/13/index.php

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction to Biopharmaceutics and Pharmacokinetics**		
1.1	Drug Product Performance, Biopharmaceutics	Explain the performance of drug products	K2
1.2	Pharmacokinetics, Pharmacodynamics, Clinical Pharmacokinetics	Summarize the principles of Pharmacokinetics & Pharmacodynamics	K2
1.3	Practical focus, Pharmacodynamics, Drug exposure and Drug Response	Discuss the effects of drug exposure and drug response	K2
1.4	Toxiocokinetics and Clinical Toxicology	Differentiate the role of toxicokinetics and clinical toxicology in pharmacology	K4
1.5	Measurement of Drug Concentrations, Basic Pharmacokinetics and Pharmacokinetic Models	Calculate the effective drug concentrations using insilico techniques	K4
2	**Combinatorial Chemistry**		
2.1	Introduction, Drug-Like Molecules, Supports and links, Solution-Phase	Recall the features of drug like molecules	K1
2.2	Combinatorial Chemistry, Pooling Strategies, Detection, Purification and Analysis	Explain the strategies of combinatorial chemistry	K2
2.3	Encoding Combinatorial Libraries, HTS, Virtual Screening	Demonstrate the steps of encoding combinatorial libraries	K3

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
2.4	Chemical Diversity and Library Design	Theorize the fundamentals of chemical diversity	K4
3	**Metabolic Changes of Drugs and Related Organic Compounds**		
3.1	General Pathways of Drug Metabolism	Discuss the drug metabolic pathways	K2
3.2	Sites of Drug Biotransformation	Review the sites of drug transformation	K2
3.3	Role of Cytochrome P-450 Monooxygenases in Oxidative Biotransformations	Demonstrate the role of Cytochrome P-450 Monooxygenases in Oxidative Biotransformations	K3
3.4	Phase II or Conjugation Reactions	Explain the basics of Conjugation Reactions	K2
3.5	Factors affecting Drug Metabolism	Summarize the factors affecting Drug Metabolism	K2
4	**Prodrugs and Drug Latentiation**		
4.1	History, Basic Concepts	Recall the basic concepts of prodrugs	K1
4.2	Prodrugs of Functional Groups, BioprecursorProdrugs Chemical Delivery Systems	Explain the functional groups of prodrug and their chemical delivery systems	K2
4.3	Biotechnology and Drug Discovery – Novel Drug-Screening Strategies, Processing of the Recombinant Protein, Pharmaceutics of rDNA Produced Agents	Analyze the strategies of novel drug screening	K4
4.4	Delivery and Pharmacokinetics of Biotechnology Products	Plan innovative strategies for the potential drug discovery	K5
5	**Pharmacovigilance**		
5.1	Introduction, Definition and Terminologies	Define the basics of Pharmacovigilance	K1
5.2	Predisposing Factors of ADRS, Importance, Surveillance Methods, Evolution of Individual ADRS	Explain the factors of ADRS	K2
5.3	Roles of Various Professionals in Pharmacovigilance, International Regulatory Agencies on Pharmacovigilance And Influence Of Pharmacoinformatics	Propose various guidelines to be followed by Professionals in Pharmacovigilance	K5
5.4	Pharmacoinformatics: Various Arenas, Future Of Pharmacoinformatics In Improving Pharmacovigilance	Report on Various Arenas and future prospects of Pharmacoinformatics	K6

4. Mapping Scheme

I23BIX18	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	M	L	M	L	M	M	M	M	M	M
CO2	M	M	M	M	L	M	L	M	M	M	H	M	M
CO3	M	M	M	M	L	M	L	M	M	M	L	M	M
CO4	M	M	M	M	L	M	-	M	L	M	L	M	M
CO5	M	M	M	M	L	M	-	M	L	M	L	M	M
CO6	M	M	M	M	L	H	-	M	L		L	L	H

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. D. Raja Sudhakar

Elec VIII : Big Data Analytics For Bioinformatics

Semester : X | **Course Code I23BIX:A**
Credits : 4 | **Hours/Week 5**

1. Course Outcomes

After completion of this course, the students will be able to:

CO. No	Course Outcomes	Level	Unit
CO1	Describe the background and Origin of Big Data	K1	I
CO2	List the terminologies related to Big Data Processing Frame	K1	II
CO3	Inspect the concepts of Deep Learning and Its Parallelization	K4	III
CO4	Apply the Statistical Methods for Genome wide Association Studies	K3	IV
CO5	Integrate statistical methods for automatic Disease Diagnosis and Disease Marker Detection	K5	IV
CO6	Evaluate the applications of big data analytics for proteome	K6	V

2. A. Syllabus

Unit I - Introduction and Basic concepts **15 Hours**

1.1 Historical Background and Origin of Big Data
1.2 Defining the types attributes, methodology and interpretation of Big Data
1.3 Big Data Analytics and Machine Learning- Cloud Computing
1.4 Terminology related to Big Data Processing Frame Works-Hadoop, HDFS, Mapreduce, Spark and Flink.- Google File System (Gfs) and HDFS - Mapreduce-Flink and Other Data Process Engines

Unit II - Deep Learning and Its Parallelization **15 Hours**

2.1 Application and Demands for Deep learning- Existing Parallel Frameworks of Deep Learning
2.2 Concepts and Categories of Deep Learning- Mainstream Deep Learning Models
2.3 Parallel Optimization for Deep Learning- Convolutional Architecture for Fast Feature Embedding- Distbelief- Deep Learning Based On Multi-GPUs

Unit III - Bio-Inspired Algorithms for Health care **15 Hours**

3.1. Introduction to Analytical Model- Bio-Inspired Algorithms

3.2 Taxonomy of big data - Evolutionary Algorithms- Swarm-Based Algorithms- EcologicalAlgorithms.

3.3 Introduction to Healthcare Data- Medical Image Processing and its role In HealthcareData Analysis- Tools used in Healthcare Data- Architectural Framework

Unit IV - Statistical Methods for Genome wide Association Studies **15 Hours**

4.1 Introduction to Heritability Estimation- and its effect on GWAS- Integrative Analysis ofMultiple GWAS—GWAS with Functional Information

4.2 Genomic Applications of the Neyman–Pearson Classification Paradigm, Simulation- Logistic Regression- Support Vector Machines- Random forests- Extension to Multi- class Sample Size Determination- Automatic Disease Diagnosis- Disease Marker Detection

Unit V - Big Data analytics for Proteome **15 Hours**

5.1 Three Dimension protein Structures for Functional Genomics, Comparative Bioinformatics and Molecular Modeling-Definition of Protein Spatial Structure- Different Level-Relative Coordinates of Protein Structures- Energy Properties of Protein Structures

5.2 Cloud Services for Scalable Computations- Azure Cloud Services (Microsoft Azure)- Virtual Machines, Series and Sizes- Cloud Services in Action

5.3 Scalable Prediction of Intrinsically Disordered Protein Regions with Spark Clusters on Microsoft Azure Cloud- Intrinsically Disordered Proteins- IDP Predictors-IDPP Meta- Predictor- Reaching Consensus- Filtering Outlie

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Bioinformatics Capstone: Big Data in Biology	https://www.coursera.org/learn/bioinformatics-project
2	Big Data, Genes, and Medicine	https://www.coursera.org/learn/data-genes-medicine
3	Big data in modern biology	https://opensource.com/life/13/4/big-data-modern-biology
4	The Use of R Packages for Big Data Analytics	https://www.opensourceforu.com/2019/11/the-use-of-r-packages-for-big-data-analytics/
5	Using Python for the Cloud and Big Data Analytics	https://www.opensourceforu.com/2015/11/using-python-for-the-cloud-and-big-data-analytics/

Additional Knowledge:

Commonly used tool for big data analysis

- Linux for Big Data Analysis-Introduction- Running Basic Linux Commands-Next-Generation
- Sequence Data Analysis by Running Basic Linux Commands-Visualizing Data in a GenomeBrowser
- Python for Big Data Analysis-Introduction to Python -Application of Python -Evolution of
- Python -Python Scripting in UNIX and Windows Environments - R for Big Data Analysis-Introduction-R Applications -Data Analysis Outline- Scripting-Analysis

C. Text Book(s)

1. RajkumarBuyya, Big Data Principles and Paradigms, 2016.
2. NilanjanDey, Big Data Analytics for Intelligent Healthcare Management, AcademicPress, 2019.
3. Ka-Chun Wong, Big Data Analytics in Genomics, 2016.
4. DariuszMrozek, Scalable Big Data Analytics for Protein Bioinformatics EfficientComputational Solutions for Protein Structures, 2018.
5. Ye, Shui Qing, Big data analysis for bioinformatics and biomedical discoveries, 2016.

D. Reference Book(s)

1. Tom White, “Hadoop: The Definitive Guide”, 4th Edition, O’Reilly Media, 2015.
2. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, "Professional Hadoop Solutions",1st Edition, Wrox Press, 2014.
3. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators",1st Edition,O'Reilly Media, 2012.
4. Arshdeep Bahga, VijayMadisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition,VPT Publications, 2018.
5. Ch. Satyanarayana Kunjam, NageswaraRao Richard G. Bush, Computational Intelligence and Big Data Analytics Applications in Bioinformatics, 2019.

E. Weblinks

1. https://nptel.ac.in/courses/106/104/106104189/
2. https://www.coursera.org/learn/data-genes-medicine

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
1	**Introduction and Basic concepts**		
1.1	Historical Background and Origin of Big Data	Summarize the historical background of big data	K2
1.2	Defining the types attributes, methodology and interpretation of Big Data	List the attributes involved in big data	K1
		Explain the methodology and interpretation of Big Data	K2
1.3	Big Data Analytics and Machine Learning- Cloud Computing	Discuss the concepts of machine learning	K2
		Review the applications of cloud computing in big data analytics	K2
1.4	Terminology related to Big Data Processing Frame Works	Define the terms involved in big data processing	K1
		Discuss about Big data processing framing works	K2
2	**Deep Learning and Its Parallelization**		
2.1	Application and Demands for Deep learning- Existing Parallel Frameworks of Deep Learning	List out the application of deep learning Concepts	K1
		Discuss the parallel frameworks of deep learning	K2
2.2	Concepts and Categories of Deep Learning- Mainstream Deep Learning Models	Categorize the deep learning models	K4
2.3	Parallel Optimization for Deep Learning- Convolutional Architecture for Fast Feature Embedding- Distbelief- Deep Learning Based On Multi-GPUs	Explain the Convolutional Architecture	K2
		State the importance of Multi-GPUs	K1
3	**Bio-Inspired Algorithms for Health care**		
3.1	Introduction to Analytical Model- Bio-Inspired Algorithms	Recognize the bio inspired algorithms	K1
3.2	Taxonomy of big data - Evolutionary Algorithms- Swarm-Based Algorithms- Ecological Algorithms	Sketch the taxonomy of Big data	K3
		Catalogue the evolutionary algorithms	K4
		Differentiate between Swarm-Based and Ecological Algorithms	K4
3.3	Introduction to Healthcare Data- Medical Image Processing and its role In Healthcare Data Analysis- Tools used in Healthcare Data- Architectural Framework	Define Healthcare Data	K1
		Relate the role of medical image processing in health care data analysis	K4
		Catalogue the tools used in Healthcare Data	K4

Unit/ Section	Course Contents	Learning Outcomes	HBTLT
4	**Statistical Methods for Genome wide Association Studies**		
4.1	Introduction to Heritability Estimation- and its effect on GWAS- Integrative Analysis of Multiple GWAS—GWAS with Functional Information	Define GWAS	K1
		Analyze GWAS using statistical methods	K4
4.2	Genomic Applications of the Neyman–Pearson Classification Paradigm, Simulation- Logistic Regression- Support Vector Machines- Random forests- Extension to Multi- class Sample Size Determination- Automatic Disease Diagnosis- Disease Marker Detection	Apply the Statistical Methods for Genome wide Association Studies	K3
		Describe the concepts of SVM, Random forests	K2
		Integrate statistical methods for automatic Disease Diagnosis and Disease Marker Detection	K5
5	**Big Data analytics for Proteome**		
5.1	Three Dimension protein Structures for Functional Genomics, Comparative Bioinformatics and Molecular Modeling- Definition of Protein Spatial Structure- Different Level-Relative Coordinates of Protein Structures- Energy Properties of Protein Structures	Recall the concepts of functional genomics, comparative Bioinformatics and molecular modeling	K1
		Relate the Protein Spatial Structure with its different Level	K4
5.2	Cloud Services for Scalable Computations- Azure Cloud Services (Microsoft Azure)- Virtual Machines, Series and Sizes- Cloud Services in Action	Demonstrate Microsoft Azure Cloud Services	K3
5.3	Scalable Prediction of Intrinsically Disordered Protein Regions with Spark Clusters on Microsoft Azure Cloud- Intrinsically Disordered Proteins- IDP Predictors-IDPP Meta- Predictor- Reaching Consensus- Filtering Outline	Report on Intrinsically Disordered Protein (IDP)	K6
		Investigate the tools involved in IDP prediction	K6

4. Mapping Scheme

I23BIX:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	-	L	-	L	L	M	M	L	M
CO2	H	M	L	M	-	L	-	M	L	M	M	L	M
CO3	H	M	L	L	-	L	-	M	L	M	M	L	M
CO4	H	M	L	L	L	L	-	M	L	M	M	M	M
CO5	H	M	M	H	L	M	L	M	L	M	M	M	M
CO6	H	M	L	L	L	L	-	M	L	M	M	M	M

L: Low **M: Medium** **H: High**

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. K. Akila

Elec VIII: Application of Bioinformatics in Applied Biology

Semester : X **Course Code : I23BIX:B**
Credits : 4 **Hours / Week : 5**

1. Course Outcomes

After completing the course, the students able to

CO. No	Course Outcomes	Level	Unit
CO1	State the biodiversity values and its management	K1	I
CO2	Discuss the biodiversity application software's and virtual libraries	K2	II
CO3	Explain about gene therapy and drug targets	K2	III
CO4	Analyze biotechnological application of microbes	K4	IV
CO5	Inspect the alternative energy sources	K4	IV
CO6	Review the importance of Microbial Engineering	K6	V

2. A. Syllabus

Unit I - Diversity **15 Hours**

1.1. Biodiversity Scope, Types, Values and Uses of Biodiversity, Loss of biodiversity,

1.2. Biotechnology information: Management and Communication, Libraries,Bibliographies, Periodicals, Databases,

1.3. Distribution of biodiversity information, Metadatabases, Virtual libraries, Special interest networks, Biodiversity Application Software – CD,ROMs and Diskettes.

Unit II - Agriculture **15 Hours**

2.1. Crops: Comparative genomes of plant and model plants, Insect resistance,

2.2. Improve nutritional quality, Grow drought resistant crops in poorer soils, Biodiversity of Indian medicinal plants.

Unit III - Medicine **15 Hours**

3.1 Gene therapy, Fundamentals of gene therapy, Gene therapy present and future, clinical trials.

3.2. Applications of Bioinformatics in cancer detection, Drug targets, Human genome diversity.

Unit IV - Environment **15 Hours**

4.1. Waste cleanup: Superbugs and their concept, Microbes and Climate change, Alternative energy sources and Fuel cells.

4.2. Biotechnological applications of microbes, Antibiotic resistance, Forensic analysis of microbes, the reality of bioweapon, Metagenomics.

Unit V - Synthetic Oligonucleotides **15 Hours**

5.1. Introduction, definition and Basics, Synthetic Oligonucleotide/DNA-based, RNA-based, Peptide-based

5.2. Polyketide Technologies and Applications, Technologies and Applications of Directed Evolution and Microbial Engineering.

B. Topics for Self Study:

S.No.	Topics	Web Links
1	Biodiversity	https://www.ugc.ac.in/oldpdf/modelcurriculum/Chapter4.pdf
2	Agriculture	https://www.youtube.com/watch?v=mU9ROpm6d70
3	Human Gene Therapy	https://www.youtube.com/watch?v=8K908NeuKJs
4	Medicinal Chemistry	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cy05/
5	Advanced Microbial Engineering	https://www.icgeb.org/yazdani-shams-lab/

C. Text Book(s)

1. Lukas, K., Buehler, Hooman, H. Rashidi. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press.2000.
2. Krishnamurthy, K.V. An advanced Textbook on Biodiversity - principle and practice, Oxford & IBH publishing Co. Pvt. Ltd.2003.
3. FulekarM.H.. Bioinformatics: Applications in Life and Environmental Sciences, Springer, 2009.

D. Reference Book(s)

1. Chandra Sekhar Mukhopadhyay, Ratan Kumar Choudhary, Mir Asif Iquebal, Basic Applied Bioinformatics, Wiley, 2018
2. PramodTandon, Yash P Abrol and SumanKumaria, Biodiversity and its Significance, I. K. International Publishing House Pvt. Ltd.2007.

E. Weblinks

1. https://nptel.ac.in/courses/102/104/102104068/
2. https://nptel.ac.in/courses/126/104/126104001/
3. https://nptel.ac.in/courses/120/108/120108004/

3. Specific Learning Outcomes (SLO)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Diversity**		
1.1	Diversity: Biodiversity Scope, Types, Values and Uses of Biodiversity, Loss of biodiversity,	Explain the Biodiversity Scope, Types, Values and Uses of Biodiversity, Loss of biodiversity,	K2
1.2	Biotechnology information: Management and Communication, Libraries,Bibliographies, Periodicals, Databases,	Analyze the Biotechnology information	K4
1.3	Distribution of biodiversity information, Metadatabases, Virtual libraries, Special interest networks, Biodiversity Application Software – CD,ROMs and Diskettes.	Discuss about the Metadatabases, Virtual libraries, Special interest networks, Biodiversity Application Software CD,ROMs and Diskettes.	K2
2	**Agriculture**		
2.1	Agriculture: Crops: Comparative genomes of plant and model plants, Insect resistance	Discuss the significance of Comparative genomics in agriculture	K2
2.2	Improve nutritional quality, Grow drought resistant crops in poorer soils, Biodiversity of Indian medicinal plants.	Report the role of Biotechnology in improving the quality of plants	K2
3	**Medicine**		
3.1	Medicine: Gene therapy ,Fundamentals of gene therapy, Gene therapy present and future, clinical trials.	Describe the Gene therapy, Fundamentals of gene therapy, Gene therapy present and future, clinical trials.	K2
3.2	Applications of Bioinformatics in cancer detection, Drug targets, Human genome diversity.	Summarize the applications Bioinformatics in Cancer detection	K2
4	**Environment**		
4.1	Waste cleanup: Superbugs and their concept, Microbes and Climate change, Alternative energy sources and Fuel cells	Define the Superbugs and their concept, Microbes and Climate change, Alternative energy sources and Fuel cells	K1
4.2	Biotechnological applications of microbes, Antibiotic resistance, Forensic analysis of microbes, the reality of bioweapon, Metagenomics	Review the applications of Biotechnology in Antibiotic resistance, Forensic analysis of microbes, the reality of bioweapon, Metagenomics	K6

Unit/ Section	Course Content	Learning Outcomes	HBTLT
5	Synthetic Oligonucleotides		
5.1	Introduction, definition and Basics, Synthetic Oligonucleotide/DNA-based, RNA-based, Peptide-based	Define of computational statistics and computational biology in Synthetic Oligonucleotide/DNA-based, RNA-based, Peptide-based	K1
5.2	Polyketide Technologies and Applications, Technologies and Applications of Directed Evolution and Microbial Engineering.	Review the technologies and Applications of Directed Evolution and Microbial Engineering.	K6

4. Mapping Scheme

I23BIX:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	L	L	L	L	-	M	L	H	H	M	H
CO2	M	M	L	M	L	L	L	M	L	H	H	H	H
CO3	M	M	L	L	-	L	-	M	M	H	H	M	H
CO4	M	M	L	L	-	L	L	M	M	H	H	M	H
CO5	M	M	L	L	-	L	-	M	M	H	H	M	H
CO6	M	M	L	L	-	L	-	M	M	H	H	M	H

L: Low M: Medium H: High

5. Course Assessment Methods

Direct

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, project Report, Field Visit Report, Poster Presentation, Seminar, Quiz (written).
4. Pre-Semester & End Semester Theory Examination

Indirect

Course end survey (Feedback)

Name of the Course Coordinator: Dr. K. Akila