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

UNDERGRADUATE DEGREE PROGRAMME

B.Sc., BIOINFORMATICS (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Three Years

B.Sc., (Hons) BIOINFORMATICS (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)
Four Years

CURRICULUM & SYLLABUS

REGULATION 2024

Choice Based Credit System (CBCS)
&
Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year
2025 -2026

Department of Bioinformatics
School of Life Sciences

DEPARTMENT OF BIOINFORMATICS

VISION OF THE DEPARTMENT

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

MISSION OF THE DEPARTMENT

To facilitate, conduct and organize research work by teams comprised of core groups leading to inventions and to cooperate to meet this end and also to work acquiring the patents of such inventions.

With its strong commitment to education, the department expects its graduates to have acquired solid subject knowledge and laboratory skills in the field of Bioinformatics upon their graduation.

In addition, with our innovative curriculum, the graduates are also expected to possess all- round competence in IT technology, information gathering and synthesis, critical thinking, efficient oral and written communication, and teamwork spirit and capability so that their career prospects go beyond the field of life sciences.

PROGRAMME EDUCATIONAL OUTCOMES (PEO)	
PEO1	An ability to develop the practical knowledge related to Life science, Computer science and information technology in an interdisciplinary manner for providing innovative ideas to solve the biological problems and promote the research globally.
PEO2	The extraordinary skills to analyse the scientific big data, create a novel objective, implement methodology to derive a key finding and apply this knowledge for welfare of society. Students should be able to develop as computational expert and follow the ethical rules on areas related to Life sciences and Bioinformatics
PEO3	Develop as a resource person with interdisciplinary knowledge who can finish the advance tasks related to biology and computer science in a challenging scientific environment.
PEO4	Update knowledge on programming and database development on biological data and information and help the scientific research community.
PEO5	U.G. program and its knowledge give confidence to the students and shine in the booming bioinformatics careers related to academics, research and development and industry.

PROGRAMME OUTCOMES (PO)	
PO1	**Scientific knowledge**: Graduates will acquire bioinformatics specific knowledge including recent techniques in the respective fields coupled with hands-on skills and leadership skills for a successful career.
PO2	**Problem analysis**: Graduates will be able to analyze, solve and troubleshoot problems in implementation of bioinformatics protocols
PO3	**Design/development of solutions:** Graduates will develop creative thinking and cooperate with each other to solve problems in the field of bioinformatics.
PO4	**Conduct investigations of Practical problems:** Graduates will acquire practical skills – which help in planning and designing protocols to validate hypothesis.
PO5	**Conduct investigations of experimental problems:** Graduates will acquire execute experimental techniques independently as well as assimilate, analyze and interpret subsequent data.

PO6	**Modern tool usage and communication:** Graduates will effectively be able to manage resources and time using ICT and computer enabled devices and accomplish ability to understand and communicate all ideas effectively.
PO7	**Environment sustainability and Ethics:** Graduates will get adequate knowledge to use information and implement solutions for environmental protection and remediation.
PO8	**Role and responsibilities:** Graduates will be aware of their role and responsibility in handling and use of microbes including genetically modified microorganisms.
PO9	**Lifelong learning:** Graduates will carry on to learn and adapt in a world of constantly evolving technology.
PO10	**Application:** To gain a sound knowledge on the application of computer techniques in the field of chemistry, plants, etc.
PO11	**Analysis of biological data:** To be well versed in handling the biological data from the different database available online at present.
PO12	**Maintenance of biological database:** To implement the computer programming knowledge in the design and maintenance of database to utilize the complex form of biological data in a simpler format.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1	Demonstrate a strong foundational understanding of biological sciences by integrating core biological principles with computational thinking to analyze and interpret biological data effectively.
PSO2	Apply programming knowledge and data science techniques including AI and machine learning to design tools, develop databases, and solve problems in genomics, drug discovery, and systems biology.
PSO3	Utilize bioinformatics tools and web technologies to develop innovative solutions in healthcare, pharmaceutical, and biotechnological industries, fostering research and entrepreneurship in interdisciplinary domains.

BOARD OF STUDIES

List of Members

Department of Bioinformatics

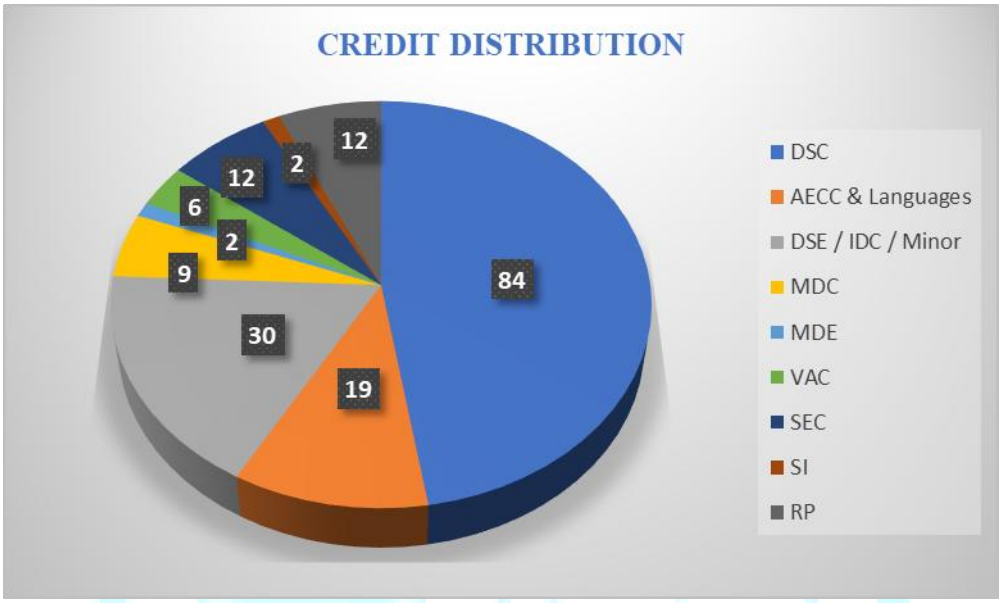
S. No	Name & Designation	Address	Role
1.	Dr. Radha Mahendran	Professor & Head, Department of Bioinformatics, VISTAS, Chennai	Chairman
2.	Dr. R. Priya	Assistant Professor, Department of / Bioinformatics, VISTAS, Chennai	Internal Member
3.	Dr. P.R. Kiresee Saghana	Assistant Professor, Department of / Bioinformatics,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

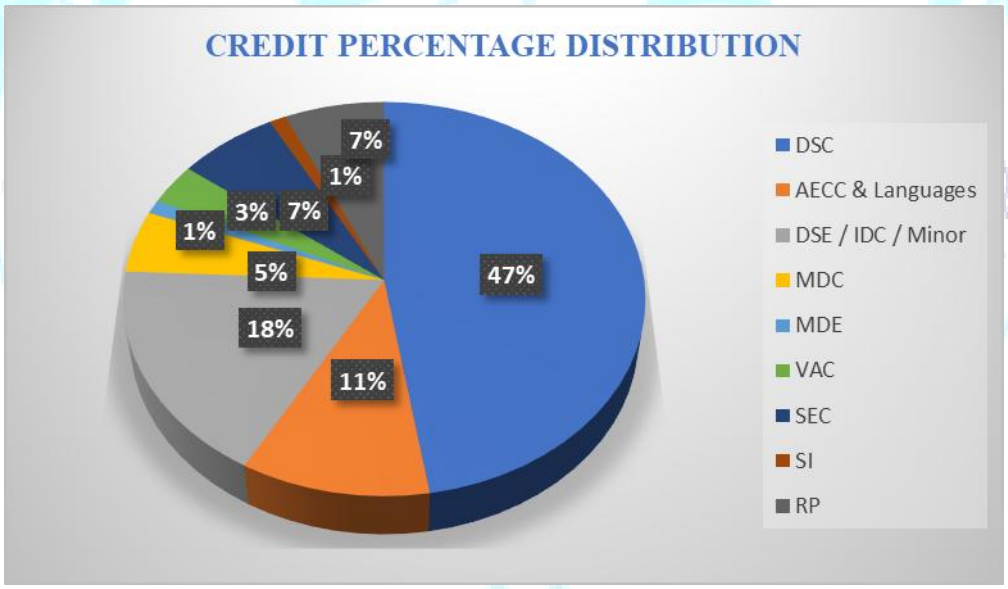
CREDIT DISTRIBUTION

B.Sc., Bioinformatics (Artificial Intelligence and Data Science) Three Years
Minimum credits to be earned: 132

BSc., (Hons) Bioinformatics (Artificial Intelligence and Data Science) Four Years
Minimum credits to be earned: 176

Component	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	3 Yrs. Total Credits	VII Sem	VIII Sem	4 Yrs Total Credits
DSC	8	8	8	8	12	16	60	12	12	84
AECC & Languages	4	4	4	7	-	-	19	-	-	19
DSE / IDC / Minor	4	4	3	4	4	3	22	4	4	30
MDC	3	3	3	-	-	-	9	-	-	9
MDE	-	-	2	-	-	-	2	-	-	2
VAC	1	2	-	1	2	-	6	-	-	6
SEC	2	2	2	2	2	2	12	-	-	12
SI	-	-	1	-	1	-	2	-	-	2
RP	-	-	-	-	-	-	-	6	6	12
Total Credits	22	23	23	22	21	21	132	22	22	176


CREDIT DISTRIBUTION
84
19
30
9
2
6
12
2
12
DSC
AECC & Languages
DSE / IDC / Minor
MDC
MDE
VAC
SEC
SI
RP


CREDIT PERCENTAGE DISTRIBUTION
47%
11%
18%
5%
1%
3%
7%
1%
7%
DSC
AECC & Languages
DSE / IDC / Minor
MDC
MDE
VAC
SEC
SI
RP

ABBREVIATIONS

DSC	Disciplinary Specific Core
AECC	Ability Enhancement Compulsory Courses
DSE	Disciplinary Specific Elective
IDC	Interdisciplinary / Minor Courses
MDC	Multidisciplinary Courses
MDE	Multidisciplinary Elective
VAC	Value Added Courses
SEC	Skill Enhancement Courses
SI	Summer Internship

CURRICULUM STURCTURE

B.Sc., Bioinformatics (Artificial Intelligence and Data science) Three Years

/

BSc., (Hons) Bioinformatics (Artificial Intelligence and Data science) Four Years

Total number of Credits: 176

	B.Sc., (Hons) Bioinformatics (Artificial Intelligence and Data Science) Four Years Minimum Credits to be earned :176 B.Sc., Bioinformatics (Artificial Intelligence and Data Science) Minimum Credits to be earned: 132									
	SEMESTER I									
			Hours/Week					Maximum Marks		
Category	Code	Course	L	T	P	O	C	CIA	SEE	Total
LANG 1	24LTAM11/ 24LHIN11/ 24LFRE11	Tamil I / Hindi I/ French I	2	0	0	1	2	40	60	100
ENG 1	24LENG11	English I	2	0	0	1	2	40	60	100
DSC 1	24CBIA11	Introduction to Bioinformatics	3	0	0	2	3	40	60	100
DSC 2	24CBIA12	Fundamentals of Computer	4	0	0	2	4	40	60	100
MDC 1	24MBIA11	Introduction to Cell Biology and Biomolecules	3	0	0	2	3	40	60	100
DSE 1	24DBIA11	Discipline Specific Elective – I	4	0	0	2	4	40	60	100
DSC 1 (lab)	24PBIA11	Introduction to Bioinformatics Practical I	0	0	2	1	1	40	60	100
VAC 1	24DVAC11	Universal Human Values	1	0	0	1	1	-	100	100
SEC 1	24SSKU11	Soft Skills I	2	0	0	1	2	40	60	100
SEC 2		Orientation programme / Industrial Visit	-	-	-	-	-	-	-	-
			21	-	2	-	22	-	-	-

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

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

SEMESTER 2										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
LANG 2	24LTAM21/ 24LHIN21/ 24LFRE21	Tamil II / Hindi II / French II	2	0	0	1	2	40	60	100
ENG 2	24LENG21	English II	2	0	0	1	2	40	60	100
DSC 3	24CBIA21	Programming in C++	3	0	0	2	3	40	60	100
DSC 4	24CBIA22	Biological Database and Sequence Analysis	3	0	0	2	3	40	60	100
MDC 2	24MBIA21	Immunology and Microbiology	3	0	0	2	3	40	60	100
DSE 2	24DBIA21	Discipline Specific Elective - II	4	0	0	2	4	40	60	100
DSC 3 (lab)	24PBIA21	Programming in C++ Practical II	0	0	2	1	1	40	60	100
DSC 4 (lab)	24PBIA22	Biological Database and Sequence Analysis Practical III	0	0	2	1	1	40	60	100
VAC 2	24DVAC21	Communication Skills	2	0	0	1	2	40	60	100
SEC 3	24SSKU12	Soft Skills II	2	0	0	1	2	40	60	100
			21	**-**	**4**	**-**	**23**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

SEMESTER 3										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
LANG 3	24LTAM31/ 24LHIN31/ 24LFRE31	Tamil III / Hindi III / French III	2	0	0	1	2	40	60	100
ENG 3	24LENG31	English III	2	0	0	1	2	40	60	100
DSC 5	24CBIA31	Programming in Java	3	0	0	2	3	40	60	100
DSC 6	24CBIA32	Recombinant DNA Technology	3	0	0	2	3	40	60	100
MDC 3	24MBIA31	Enzymes and Metabolism	3	0	0	2	3	40	60	100
DSE 3	24DBIA31	Discipline Specific Elective – III	3	0	0	2	3	40	60	100
DSC 5 (Lab)	24PBIA31	Programming in Java Practical IV	0	0	2	1	1	40	60	100
DSC 6 (Lab)	24PBIA32	Recombinant DNA Technology Practical IV	0	0	2	1	1	40	60	100
MDE 1	24EMDE31	Indian Knowledge System	1	1	0	1	2	40	60	100
SEC 4	24SSKU13	Soft Skills III	2	0	0	1	2	40	60	100
SI 1	24IBIA31	Internship I	0	0	2	1	1	-	100	100
			19	**1**	**6**	**-**	**23**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

SEMESTER 4										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
LANG 4	24LTAM41/ 24LHIN41/ 24LFRE41	Tamil IV / Hindi IV / French IV	2	0	0	1	2	40	60	100
ENG 4	24LENG41	English IV	2	0	0	1	2	40	60	100
AECC 1	24EVS041	Environmental Studies	3	0	0	2	3	40	60	100
DSC 7	24CBIA41	Programming in Perl	3	0	0	2	3	40	60	100
DSC 8	24CBIA42	Phytochemistry	3	0	0	2	3	40	60	100
DSE 4	24DBIA41	Discipline Specific Elective – IV	4	0	0	2	4	40	60	100
DSC 7 (Lab)	24PBIA41	Programming in Perl Practical V	0	0	2	1	1	40	60	100
DSC 8 (Lab)	24PBIA42	Phytochemistry Practical VI	0	0	2	1	1	40	60	100
SEC 5	24SBIA41	Industry Oriented Employability skills	1	0	2	1	2	40	60	100
VAC 3	24DVAC41	Yoga Education / NSS / NCC	0	0	2	1	1	-	100	100
SEC 6		In-plant Training/ Industrial Tour/ Summer Term	-	-	-	-	-	-	-	-
			18	**-**	**8**	**-**	**22**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

SEMESTER 5										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 9	24CBIA51	Systems Biology	3	0	0	2	3	40	60	100
DSC 10	24CBIA52	Programming in python for bioinformatics	4	0	0	2	4	40	60	100
DSE 5	24DBIA51	Discipline Specific Elective – V	4	0	0	2	4	40	60	100
DSC 9 (Lab)	24PBIA51	System Biology VII	0	0	2	1	1	40	60	100
DSC 10 (Lab)	24PBIA52	Programming in python for Bioinformatics Practical VIII	0	0	2	1	1	40	60	100
MDE 2	24EMDE51	Cyber security	3	0	0	2	3	40	60	100
SEC 7	24SBIA51	Entrepreneurial Development	2	0	0	1	2	40	60	100
VAC 4	24DVAC51	Next Generation Sequencing	2	0	0	1	2	40	60	100
SI 2	24IBIA51	Internship II	0	0	2	1	1	-	100	100
SEC 8		Skill Enhancement Training / Student Club Activities/ Institution Innovation Council Activities	-	-	-	-	-	-	-	-
			18	**-**	**6**	**-**	**21**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

SEMESTER 6										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 11	24CBIA61	R programming language and big data Analytics	3	0	0	2	3	40	60	100
DSC 12	24CBIA62	Data Science in Bioinformatics	4	0	0	2	4	40	60	100
DSC 13	24CBIA63	Artificial Intelligence and its Application in Bioinformatics	4	0	0	2	4	40	60	100
DSC 14	24CBIA64	Microbial genomics and Metagenomics	4	0	0	2	4	40	60	100
DSE 6	24DBIA61	Discipline Specific Elective – VI	3	0	0	2	3	40	60	100
DSC 11 (Lab)	24PBIA61	R programming language and big data Analytics practical IX	0	0	2	1	1	40	60	1003
SEC 9	24PBIA62	Mini Project	0	0	4	1	2	-	100	100
SEC 10		On Job Training / Apprenticeship / Startup	-	-	-	-	-	-	-	-
			18	**-**	**6**	**-**	**21**	-	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

SEMESTER 7										
			Hours/Week					Maximum Marks		
Category	Code	Course	L	T	P	O	C	CIA	SEE	Total
DSC 15	24CBIA71	Computer Aided Drug Designing	3	0	0	2	3	40	60	100
DSC 16	24CBIA72	Advanced Bioinformatics Algorithms	4	0	0	2	4	40	60	100
DSC 17	24CBIA73	Structural Bioinformatics	4	0	0	2	4	40	60	100
DSE 7	24DBIA71	Discipline Specific Elective – VII	4	0	0	2	4	40	60	100
DSC 15 (Lab)	24PBIA71	Computer Aided Drug Designing Practical X	0	0	2	1	1	40	60	100
RP 1	24RBIA71	Research Project I	0	0	12	4	6	40	60	100
			15	-	14	-	22	-	-	-

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

KNOWLEDGE IS POWER

SEMESTER 8										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 18	24CBIA81	Database Management System	3	0	0	2	3	40	60	100
DSC 19	24CBIA82	Molecular modelling and simulations	3	0	0	2	3	40	60	100
DSC 20	24CBIA83	Datamining and Machine learning	4	0	0	2	4	40	60	100
DSE 8	24DBIA81	Discipline Specific Elective – VIII	4	0	0	2	4	40	60	100
DSC 18 (Lab)	24PBIA81	Database Management System Practical XI	0	0	2	1	1	40	60	100
DSC 19 (Lab)	24PBIA82	Molecular modelling and Simulations Practical XII	0	0	2	1	1	40	60	100
RP 2	24RBIA81	Research Project II	0	0	12	4	6	-	60	100
			14	**-**	**16**	**-**	**22**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

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

DISCIPLINE SPECIFIC CORE COURSES

Category	Code	Course	L	T	P	O	C
DSC 1	24CBIA11	Introduction to Bioinformatics	3	0	0	2	3
DSC 2	24CBIA12	Fundamentals of Computer	4	0	0	2	4
DSC 1 (Lab)	24PBIA11	Introduction to Bioinformatics Practical I	0	0	2	1	1
DSC 3	24CBIA21	Programming in C++	3	0	0	2	3
DSC 4	24CBIA22	Biological Database and Sequence Analysis	3	0	0	2	3
DSC 3 (Lab)	24PBIA21	Programming in C++ Practical II	0	0	2	1	1
DSC 4 (Lab)	24PBIA22	Biological Database and Sequence Analysis Practical III	0	0	2	1	1
DSC 5	24CBIA31	Programming in Java	3	0	0	2	3
DSC 6	24CBIA32	Recombinant DNA Technology	3	0	0	2	3
DSC 5 (Lab)	24PBIA31	Programming in Java Practical IV	0	0	2	1	1
DSC 6 (Lab)	24PBIA32	Recombinant DNA Technology Practical IV	0	0	2	1	1
DSC 7	24CBIA41	Programming in Perl	3	0	0	2	3
DSC 8	24CBIA42	Phytochemistry	3	0	0	2	3
DSC 7 (Lab)	24PBIA41	Programming in Perl Practical V	0	0	2	1	1
DSC 8 (Lab)	24PBIA42	Phytochemistry Practical	0	0	2	1	1
DSC 9	24CBIA51	Systems Biology	3	0	0	2	3
DSC 10	24CBIA52	Programming in python for Bioinformatics	4	0	0	2	4
DSC 9 (Lab)	24PBIA51	Systems Biology Practical VII	0	0	2	1	1
DSC 10	24PBIA52	Programming in python for	0	0	2	1	1

(Lab)		Bioinformatics Practical VIII					
DSC 11	24CBIA61	R programming language and big data Analytics	3	0	0	2	3
DSC12	24CBIA62	Data science in Bioinformatics	4	0	0	2	4
DSC 13	24CBIA63	Artificial Intelligence and its Application in Bioinformatics	4	0	0	2	4
DSC 14	24CBIA64	Microbial genomics and Metagenomics	4	0	0	2	4
DSC 11 (Lab)	24PBIA61	R programming language and big data Analytics practical IX	0	0	2	1	1
DSC 15	24CBIA71	Computer Aided Drug Designing	3	0	0	2	3
DSC 16	24CBIA72	Advanced Bioinformatics Algorithms	4	0	0	2	4
DSC 17	24CBIA73	Structural Bioinformatics	4	0	0	2	4
DSC 15 (Lab)	24PBIA71	Computer Aided Drug Designing Practical X	0	0	2	1	1
DSC 18	24CBIA81	Database Management System	3	0	0	2	3
DSC 19	24CBIA82	Molecular modelling and simulations	3	0	0	2	3
DSC 20	24CBIA83	Datamining and Machine learning	4	0	0	2	4
DSC 18 (Lab)	24PBIA81	Database Management System Practical XI	0	0	2	1	1
DSC 19 (Lab)	24PBIA82	Molecular modelling and Simulations Practical XII	0	0	2	1	1

DISCIPLINE SPECIFIC ELECTIVE COURSES

Category	Code	Course	L	T	P	O	C
DSE 1	24DBIA1_	Mathematics and Biostatistics	4	0	0	2	4
	24DBIA1_	Biophysical Chemistry	4	0	0	2	4
DSE 2	24DBIA2_	Molecular Biology	4	0	0	2	4
	24DBIA2_	Web Programming	4	0	0	2	4
DSE 3	24DBIA3_	Medical Coding and Transcription	3	0	0	2	3
	24DBIA3_	Medicinal Chemistry	3	0	0	2	3
DSE 4	24DBIA4_	Genomics and Proteomics	4	0	0	2	4
	24DBIA4_	Molecular Microbial Pathogenesis	4	0	0	2	4
DSE 5	24DBIA5_	Cancer Biology	4	0	0	2	4
	24DBIA5_	UNIX Programming	4	0	0	2	4
DSE 6	24DBIA6_	Applied Clinical Pharmacokinetics	3	0	0	2	3
	24DBIA6_	Biosafety, Bioethics and IPR	3	0	0	2	3
DSE 7	24DBIA7_	Enzyme Engineering and Technology	4	0	0	2	4
	24DBIA7_	Computational Intelligence	4	0	0	2	4
DSE 8	24DBIA8_	Bioinformatics in Immunology, Microbiology and Nanotechnology	4	0	0	2	4
	24DBIA8_	Metabolomics and Metabolic Engineering	4	0	0	2	4

AECC & LANGUAGES

Category	Code	Course	L	T	P	O	C
LANG 1	24LTAM11/ 24LHIN11/ 24LFRE11	Tamil I / Hindi I/ French I	2	0	0	1	2
ENG 1	24LENG11	English I	2	0	0	1	2
LANG 2	24LTAM21/ 24LHIN21/ 24LFRE21	Tamil II / Hindi II / French II	2	0	0	1	2
ENG 2	24LENG21	English II	2	0	0	1	2
LANG 3	24LTAM31/ 24LHIN31/ 24LFRE31	Tamil III / Hindi III / French III	2	0	0	1	2
ENG 3	24LENG31	English III	2	0	0	1	2
LANG 4	24LTAM41/ 24LHIN41/ 24LFRE41	Tamil IV / Hindi IV / French IV	2	0	0	1	2
ENG 4	24LENG41	English IV	2	0	0	1	2
AECC 1	24EVS041	Environmental Studies	3	0	0	2	3

MULTIDISCIPLINARY COURSES

Category	Code	Course	L	T	P	O	C
MDC 1	24MBIA11	Introduction to Cell Biology and Biomolecules	3	0	0	2	3
MDC 2	24MBIA21	Immunology and Microbiology	3	0	0	2	3
MDC 3	24MBIA31	Enzymes and Metabolism	3	0	0	2	3

MULTIDISCIPLINARY ELECTIVES

Category	Code	Course	L	T	P	O	C
MDE 1	24EMDE31	Indian Knowledge System	1	1	0	1	2
MDE 2	24EMDE51	Cyber security	3	0	0	2	3

VALUE ADDED COURSES

Category	Code	Course	L	T	P	O	C
VAC 1	24DVAC11	Universal Human Values	1	0	0	1	1
VAC 2	24DAVC21	Communication Skills	2	0	0	1	2
VAC 3	24DVAC41	Yoga Education / NSS / NCC	0	0	2	1	1
VAC 4	24DVAC51	Next Generation Sequencing	2	0	0	1	2

SKILL ENHANCEMENT COURSES

Category	Code	Course	L	T	P	O	C
SEC 1	24SSKU11	Soft Skills I	2	0	0	1	2
SEC 2		Orientation Programme / Industrial Visit	-	-	-	-	-
SEC 3	24SSKU12	Soft Skills II	2	0	0	1	2
SEC 4	24SSKU13	Soft Skills III	2	0	0	1	2
SEC 5	24SBCM41	Industry Oriented Employability skills	1	0	2	1	2
SEC 6		In-plant Training/ Industrial Tour/ Summer Term	-	-	-	-	-
SEC 7	24SBIA51	Entrepreneurial Development	2	0	0	1	2
SEC 8		Skill Enhancement Training / Student Club Activities/ Institution Innovation Council Activities	-	-	-	-	-
SEC 9	25PBIA62	Mini Project	0	0	4	1	2
SEC 10		On Job Training / Apprenticeship / Startup	-	-	-	-	-

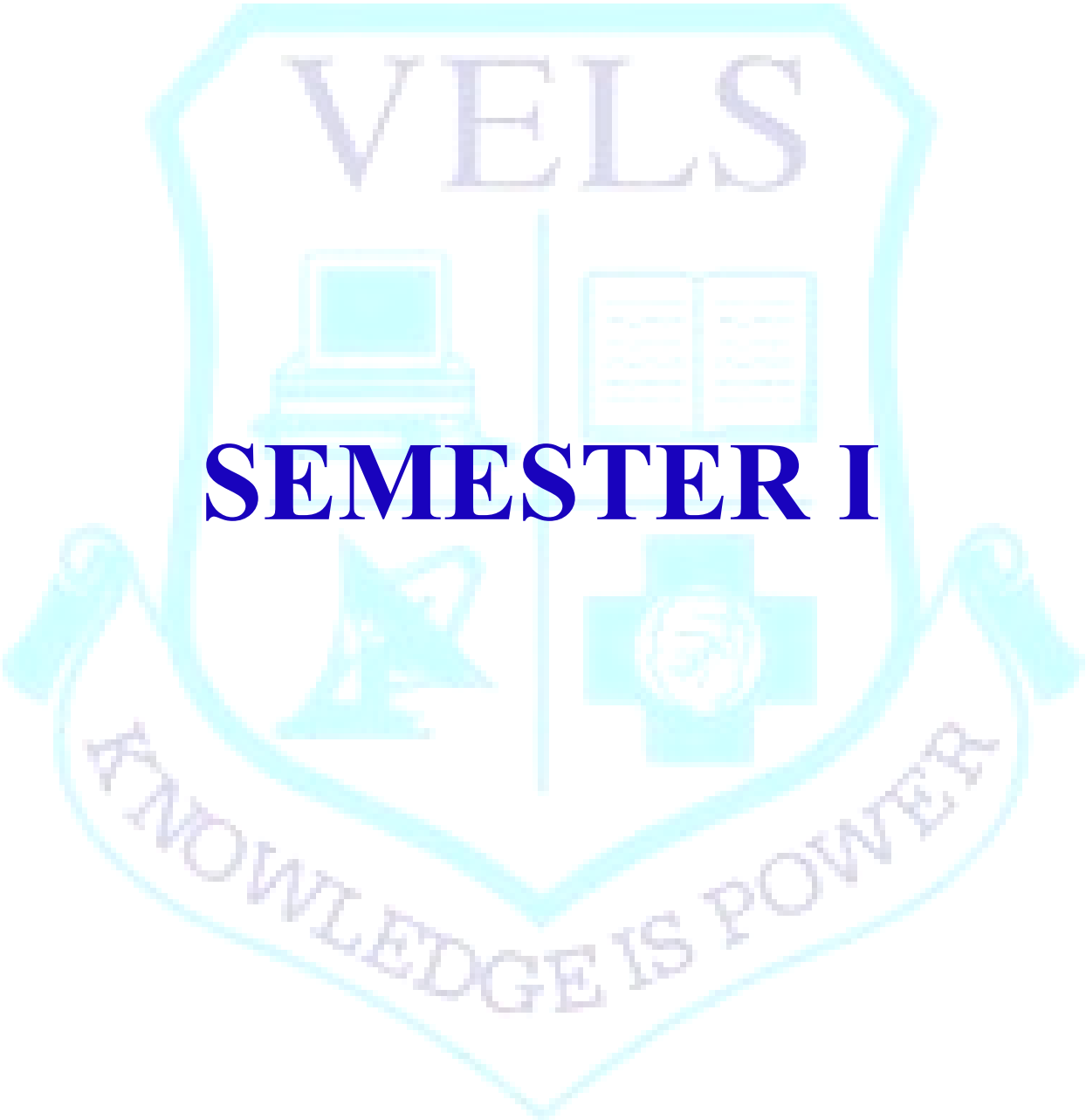
SUMMER INTERNSHIP

Category	Code	Course	L	T	P	O	C
SI 1	24IBIA31	Internship I	0	0	2	1	1
SI 2	24IBIA51	Internship II	0	0	2	1	1

RESEARCH PROJECT

Category	Code	Course	L	T	P	O	C
RP 1	24RBIA71	Research Project I	0	0	12	4	6
RP 2	24RBIA81	Research Project II	0	0	12	4	6

KNOWLEDGE IS POWER



SEMESTER I

24LTAM11 மொழிவரலாறு - சங்க இலக்கியம் அறஇலக்கியம் மொழித்திறன்

L	T	P	O	C
2	0	0	1	2

பருவம்-1, தமிழ்மொழிப்பாடம்-1, பகுதி-1, தகுதிப்புள்ளி: 2, வாரப் பாட நேரம்: 2. தாள்-1

பாடத்திட்ட நோக்கம்:

மாணவர்களின் இலக்கிய நாட்டத்தை மேம்படுத்துதல், தற்கால தமிழ் இலக்கிய வகைமைகளான மரபுக்கவிதை, புதுக்கவிதை, உரைநடை ஆகியவற்றை அறிமுகப்படுத்துதல், தமிழர்தம் வாழ்வியல் நெறிகளையும் பண்பாட்டுச் செழுமைகளையும் இன்றைய தலைமுறையினர் அறியச் செய்தல், மாணவர்களுக்குத் தமிழைத் தவறின்றி எழுதுவதற்குத் தேவையான பயிற்சி அளித்து அவர்களின் மொழித்திறனை மேம்படுத்துதல், செய்யுளின் நலத்தைப் பாராட்டும் முறைமையை அறியச் செய்து அதன்வழி சிந்தனை வளத்தைப் பெருகச் செய்தல் என்பனவும் மேற்கண்டவழி மாணவர்களை ஆளுமை மிக்கவர்களாக உருவாக்கி, போட்டித்தேர்வுகளுக்குத் தயார் செய்து அவர்களுக்கு வேலைவாய்ப்பை உருவாக்குவதும் இந்தப் பாடத்திட்டத்தின் முக்கிய நோக்கமாகும்.

அலகு- 1: தமிழ் மொழி வரலாறு 8மணி நேரம்

மொழிக்குடும்பம் - இந்திய மொழிக்குடும்பங்கள் - இந்திய ஆட்சி மொழிகள் - திராவிட மொழிக்குடும்பங்கள் - திராவிட மொழிகளின் வகைகள் –திராவிட மொழிகளின் சிறப்புகள் - திராவிட மொழிகளின் வழங்கிடங்கள் - திராவிட மொழிகளுள் தமிழின் இடம் - தமிழ்மொழியின் சிறப்புகள் - தமிழ் பிறமொழித் தொடர்புகள்.

அலகு -2 8 மணி நேரம்

புறநானூறு- பாடல் எண்: , 182, 183, – இரண்டு பாடல்கள்.

குறுந்தொகை- பாடல் எண்: 2, 167, - இரண்டு பாடல்கள்

பரிபாடல் - முருகன். வையை - இரண்டு பாடல்கள்

அலகு - 3 அற இலக்கியங்கள் 07 மணி நேரம்

திருக்குறள்- வான்சிறப்பு (அறம்), பெருமை (பொருள்), பிரிவாற்றாமை (இன்பம்),. மூன்று அதிகாரங்கள் முழுமையும்

1. நாலடியார் - இரண்டு பாடல்கள். (2, 3)

2. மூதுரை - இரண்டு பாடல்கள். (2, 8)

அலகு 4 மொழி 07 மணி நேரம்

பிழை நீக்கி எழுதுதல் - ஒற்றுப்பிழை நீக்கி எழுதுதல் - தொடர்பிழை நீக்கி எழுதுதல் - ஒற்று மிகும் இடங்கள் - ஒற்று மிகா இடங்கள் - பிற மொழிச் சொற்களை நீக்கி எழுதுதல் – பயிற்சிகள்.

மொத்தம்: 30 மணி நேரம்

பார்வை நூல்கள்

1. டாக்டர் அ. தட்சிணாமூர்த்தி (2001), தமிழர் நாகரிகமும் பண்பாடும், ஐந்திணைப் பதிப்பகம்,.

2. மா. நன்னன் (1999), தவறின்றித் தமிழ் எழுதுவோம், , ஏகம் பதிப்பகம்,

3. மருதூர் அரங்கராசன் (2002), தமிழ் இலக்கிய வரலாறு, வரதராசன், மு., புது தில்லி : சாகித்திய அக்காதெமி,

4. சிற்பி பாலசுப்ரமணியம் (2007), புதிய தமிழ் இலக்கிய வரலாறு, , , சாகித்திய அகாடெமி,.

5. முனைவர் மறைமலை இலக்குவனார், செம்மொழி தமிழின் சிறப்பியல்புகள் -; https://www.youtube.com/watch?v=HHZnmJb4jSY

6. பாடநூல் தேடலுக்கான இணையம் - https://archive.org/

24LHIN11 **वर्ष I – सत्र I (गद्य, पत्र लेखन & व्यावहारिक हिन्दी)**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To understand the rural life style, social responsibilities and social values
- To create awareness about the importance of varied culture
- To enable the students to develop communication skill in Hindi and to use Azhagi, Azhagi+ fonts

UNIT I: पं.श्रीराम शर्मा कृत 'स्मृति' (कहानी)

'Smruti' (Kahani) by Pandit Sriram Sharma. 6hrs.

UNIT II: शरद जोशी कृत 'अतिथि तुम कब जावोगे' (व्यंग्य)

'Athiti tum kab jaaoge' (Vyangy) by Sharad Joshi. 6hrs.

UNIT III: राहुल सांस्कृतयायन कृत 'अथातो घुमक्कड़ जिज्ञासा'(यात्रा वृत्तान्त)

'Atatho Ghumakkad Jigyasa' (Yatra Vruthanth) by Rahul Sanskrityayan. 6hrs.

UNIT IV: व्यावहारिक हिन्दी- पत्र लेखन में प्रयुक्त वाक्यांश, कौशल विकास – भाव एक भाषा अनेक

Functional Hindi-Phrases used in Letter Writing.
Skill development - Bhav Ek Bhasha Anek 6hrs.

UNIT V: पत्र लेखन – परिचय व प्रकार, 3 अनोपचारिक पत्र अलगी, अलगी + फ़ॉन्ट का परिचय

Letter Writing- Intro. & Types & 3 Personal Letters
Introduction to Azhagi, Azhagi + fonts 6hrs.

Total: 30hrs.

COURSE OUTCOMES:

At the end of this course Students will be able to

CO1: Gain knowledge about the rural life style

CO2: Understand social values

CO3: Understand importance of varied culture

CO4: Journalise in Functional Hindi

CO5: Use Azhagi, Azhagi+ fonts

TEXT BOOKS:

1. Pandit Shriram Sharma, Shikaar, Sahitya (1932), Sadan.
2. Sharad Joshi, Yatha Sambhav (2014), Bharatiya Gyanpeet.

3. Rahul Sanskrityayan, Ghumakkad Shastra (1949), Rajkamal Prakashan.

REFERENCE BOOK:

1. Kendriya Hindi Sansthan (2012), Banking Hindi Patyakram.
2. NCERT, Sparsh, Class 9.
3. Main Aur Mera Vyakaran, New Saraswati House, New Delhi.
4. Govind Ballabh Sharma (2022), Hindi Vyavaharik Tankan Kala Evam Tankan Abhyas, Neelkanth Publishers Pvt. Ltd.

WEBLINKS:

1. Pandit Sriram Sharma ka kahani: https://www.evidyarthi.in
2. Harishankar parasayi ka Vyangy: http://gadyakosh.org
3. Rahul Sanskrityayan ka yatravruttant: https://www.hindwi.org
4. Prayojanmoolak Hindi:https://hi.mwikipedia.org
5. https://www.azhagi.com/hnd/helphtml/Introduction.html

24LFRE11 **FRENCH PAPER 1**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

The lessons are being chosen:

- to greet, to express excuse and to introduce oneself
- to introduce another person
- to express his/her ideas, opinions and weekend projects
- to request someone to do something, polite manners
- to accept, refuse, enquire and indicate the time and date
- to express himself / herself in positive and negative manner

UNIT 1 Salut 4 hours

les nombres, Les jours de la semaine et du mois, La nationalité

UNIT 2 Enchanté 6 hours

Les verbes Etre, Avoir, Aller, Regular ER verbes, Present tense.

UNIT 3 J'Adore 4 hours

La negation, l'adjectif possessif, le futur proche

UNIT 4 Tu veux bien 7 hours

Les articles de finis/indéfinis, Les pronoms après une préposition (avec lui, chez moi),

Le passé composé

UNIT 5 On se voit quand 5 hours

Les pronoms compléments directs me, te, nous, vous, L'interrogation avec est-ce que,

L'heure et

UNIT 6 Bonne idée 4 hours

Les articles partitifs, Le masculin et le féminin des adjectifs, Les pronoms compléments directs le, la, les, La négation : ne… pas de.

Total hours - 30 hours

COURSE OUTCOMES:

- The students would be able to greet, to excuse and to introduce himself
- The students would be able to introduce someone
- The students would be able to express his ideas, opinions and weekend projects
- The students would be able to ask someone to do something, polite manner
- The students would be able to accept, refuse enquire and indicate the time and date
- The students would be able to express himself in positive and negative manner

TEXT / REFERENCE BOOK:

Prescribed book: LATITUDES 1 (A1/A2) MÉTHODE DE FRANÇAIS - Régine Mérieux and Yves Loiseau

Reference book: SAISON A1 - MÉTHODE DE FRANÇAIS - Marie-Noëlle Cocton, Élodie Heu, Catherine Houssa, Émilie Kasazian

24LENG11 **ENGLISH - I**

L	T	P	O	C
2	0	0	1	2

Course Objectives:

- Build a solid foundation in English grammar (parts of speech, sentence structure, usage).
- Apply grammatical rules accurately in speaking and writing.
- Understand key literary genres (prose, poetry, drama, short stories).
- Develop reading comprehension and interpretative skills.
- Communicate ideas clearly and effectively in written and oral forms.

UNIT –I - GRAMMAR 06

- Parts of Speech, Noun- Types, Case, Number, Gender Types
- of Pronouns, Verb-Regular & Irregular verbs
- Transitive & Intransitive verbs, Strong & Weak verbs, Main & Auxiliary verbs,
- Types of Adverbs, Place of adverbs

UNIT –III – PROSE 06

- Adjectives- Position of adjectives and Comparison of adjectives
- Tenses and usage, Active voice & Passive voice, Articles, Concord,
- Type of Sentences, Sentence pattern

UNIT –III - PROSE 06

- Dangers of drug abuse - Hardin B.Jones
- Tight corners - E.V.Lucas

UNIT –IV - POETRY ***06***

- Ecology - A.K.Ramanujan
- The Owl and the Chimpanzee - Jo Camacho

UNIT –V - PLAY AND SHORT STORIES 06

- The Dear Departed - Stanley Houghton
- The Fool's Paradise- Isaac Bashevis Singer

Total: 30 Hours

Course Outcomes:

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

- **CO1**: Understand the characteristic features of the language used in the text.
- **CO2**: Strengthen their knowledge of basic grammar.
- **CO3**: Improve narrative skills after studying diverse prose and plays.
- **CO4**: Understand how to classify parts of speech and articles.
- **CO5:** Develop critical writing skills in the textual content of the syllabus.

Text Books:

- Hardin B. Jones. "Dangers of Drug Abuse." *Reading for Life*, edited collection, McGraw-Hill, 2005.
- E. V. Lucas. "Tight Corners." In *A Lucas Omnibus*, Methuen, 1953.
- K. Ramanujan. "Ecology." In Collected Poems, Oxford University Press, 1995.
- Jo Camacho. "The Owl and the Chimpanzee." In Poetry for Young Learners, Macmillan, 2000.
- Stanley Houghton. *The Dear Departed*. Samuel French Ltd., 1911.
- Isaac Bashevis Singer. "The Fool's Paradise." In *Collected Stories*, Farrar, Straus and Giroux, 1982.

Reference Books:

- Murphy, Raymond. English Grammar in Use. 5th ed., Cambridge University Press, 2019.
- Thomson, A. J., and A. V. Martinet. A Practical English Grammar. 4th ed., Oxford University Press, 1986.
- Wren, P. C., and H. Martin. High School English Grammar and Composition. Revised ed., S. Chand & Company Ltd., 2015.

Websites:

https://www.britishcouncil.orgps://owl.purdue.edu

24CBIA11 **INTRODUCTION TO BIOINFORMATICS**

L	T	P	O	C
3	0	0	2	3

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

UNIT I INTRODUCTION TO BIOINFORMATICS 09

Bioinformatics, Basic concepts of molecular biology, Introduction to DNA and Protein sequencing, Human Genome Project (HGP), Importance and applications in biology and medicine, Future of Bioinformatics: Alpha Fold, Artificial Intelligence-driven drug discovery.

UNIT II BIOINFORMATICS DATABASES 09

Bioinformatics databases - Nucleotide sequence databases, Primary databases, Secondary databases; Protein databases- Uniprot, Protein Data Bank, Data mining from biological databases for pattern recognition and hypothesis generation. Extract insights from protein interaction networks- Artificial Intelligence.

UNIT III SEQUENCE ANALYSIS 09

Sequence Analysis-Basic concepts, pairwise sequence - Homologous, Analogue, Orthologous, paralogous, Xenologous, Local and Global alignment, scoring matrices- PAM and BLOSUM matrices, Support Vector Machine, Random Forests for gene function prediction, k-means clustering to group similar sequences.

UNIT IV SEQUENCE ALIGNMENTS 09

Pairwise sequence alignments: BLAST, Multiple sequence alignments (MSA) BLAST: - Nucleotide BLAST, Protein BLAST, PSI-BLAST, Structure analysis tools and software's, Phylogenetic analysis and tree construction, BLAST vs Artificial Intelligence -driven models: ProtTrans, DeepBLAST.

UNIT V VISUALIZATION 09

Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization, structure prediction using Artificial Intelligence: DeepMind's AlphaFold DB for structure prediction exploration.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: To develop a fundamental knowledge of Bioinformatics and its applications.

CO-2: To analyze the biological data using bioinformatics databases.

CO-3: To analyze the sequence alignment of various sequences and its analogues.

CO-4: To evaluate the sensitivity and specificity of the sequence data.

CO-5: To visualize the anatomical position of the biological structure using software.

CO-6: To apply machine learning and computational tools for predicting biological functions and interactions.

CO-7: To interpret and model biological networks and pathways for understanding complex biological systems.

TEXT BOOKS:

1. Orpita Bosu, Simminder kaur Thukral. "Bioinformatics – Databases Tools and Algorithms", Oxford University Press, 2007.

REFERENCE BOOKS:

1. H. D. Ismail (2023), Bioinformatics: A Practical Guide to Next Generation Sequencing Data Analysis, Chapman & Hall/CRC Press, Boca Raton, FL, USA.
2. Y. Hasija (2023), All About Bioinformatics: From Beginner to Expert, Academic Press, Elsevier, New Delhi, India.
3. T. Dandekar and M. Kunz (2023), Bioinformatics: An Introductory Textbook, Springer Nature, Cham, Switzerland.

WEB SOURCE LINK:

1.https://www.biostat.wisc.edu/bmi576/

2. http24s://www.ebi.ac.uk/training/online/courses/introductory-bioinformatics-pathway

24CBIA12 **FUNDAMENTALS OF COMPUTER**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: To gain a fundamental understanding of the power and limits of basic models of computation, and to gain comfort with associated proof techniques. This course is designed to provide the non- science/ mathematics/ engineering/ business student an intense foundational introduction to the fundamental concepts in statistics. After completing the course, the student should be able to work basic problem and word problems in logic, set theory, counting methods, probability, and statistics.

UNIT I INTRODUCTION TO COMPUTERS 12

History of computer - Computer Generations, Types of computers, Computer components – CPU – I/P Devices and O/P devices, Functionalities of a Computer, Advantages and disadvantages, Applications of computer. Memory and memory types RAM and RAM types, ROM and ROM types, Mother Board, Memory Units, Ports.

UNIT II COMPUTER HARDWARE AND SOFTWARE 12

Hardware, Software – System software and application software (MS Word, Excel and PowerPoint), Operating system, Example of Operating System. Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Introduction to Internet, Working of Internet, Internet Services, Internet addressing, E-Mail Basics- Web Development Tools, Introduction TO HTML.

UNIT III OPERATING SYSTEMS 12

Introduction to operating Systems - Windows Commands, UNIX / Linux - basic commands - General purpose, file handling, vi editor & environment

UNIT IV VARIABLES AND ASSIGNMENT 12

Introduction of programming concepts-Input, process and output-Identifiers and Keywords, Constants and Variables, Operators: arithmetic, unary, relational, logical, assignment, conditional- Hierarchy of operators, Input and output statements, Algorithms

UNIT V FOUNDATION OF ARTIFICIAL INTELLIGENCE 12

Fundamentals of Artificial Intelligence, AI Techniques, Representation of Knowledge, Knowledge Based Systems, State Space Search. Production Systems.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To Develop a fundamental understanding of the power and limits of basic models of computers.

CO-2: To Adapt the uses of Computer Hardware.

CO-3: To Demonstrate the knowledge in Operating system.

CO-4: To Elaborate the fundamental concepts of Variables and Assignments.

CO-5: To solve the given problem in systematic way.

CO-6: To Utilize web development tools and basic HTML concepts to create simple web pages.

CO7: To Explore the foundational concepts of Artificial Intelligence, including knowledge representation and search strategies.

TEXT BOOKS:

1. E. Balagurusamy (2022), *Fundamentals of Computers*, 7th Edition, McGraw Hill Education, New Delhi, India.
2. Elaine Rich and Kevin Knight (2022), *Artificial Intelligence*, 4th Edition, McGraw Hill Education, New Delhi, India.

REFERENCE BOOKS:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne (2023), *Operating System Concepts*, 10th Edition, Wiley, Hoboken, New Jersey, USA.

2. Herbert Schildt (2022), *C++: The Complete Reference*, 4th Edition, McGraw Hill Education, New Delhi, India.

3. Eric S. Roberts (2023), *The Art and Science of Java*, 2nd Edition, Pearson Education, London, UK.

4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein (2022), *Introduction to Algorithms*, 4th Edition, MIT Press, Cambridge, Massachusetts, USA.

WEB SOURCE LINK:

1. https://www.khanacademy.org/computing/computer-science/algorithms.

24MBIA11 INTRODUCTION TO CELL BIOLOGY AND BIOMOLECULES

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE: This course covers basic properties of cells and cell organelles. It also examines properties of differentiated cell systems and tissues. The principal aim of the course is to equip students with a basic knowledge of the structural and functional properties of cells and also understanding the biological principles, and the ability to make connections across different levels of biological organization, from molecules to cells, to whole organisms, populations and ecosystems.

UNIT I CELL STRUCTURE AND FUNCTION 09

Cell as a basic unit of life. Cell theory, Prokaryotic and Eukaryotic cell- plant cell, animal cell, bacterial cell and viruses – Structure, organization, size and Shape, Stem Cells and Their Role in Differentiation, Types of Cell Junctions (Tight Junctions, Gap Junctions, Desmosomes)

UNIT II CELL MEMBRANE AND CELL ORGANELLES 09

Ultra structure of plasma membrane – fluid mosaic model, membrane fluidity, Transport across membranes - symport, antiport, uniport, active and passive transport, Structure & Functions of cell organelles: Structure of nucleus – nuclear membrane, nucleolus, chromatin, Chromatin – Types, Endoplasmic Reticulum (SER & RER), Golgi apparatus, lysosomes, microbodies (peroxysomes and glyoxysomes), ribosomes and its types. Structure and functions of mitochondria, Structure and functions of Chloroplast, Membrane Transport: Endocytosis & Exocytosis, Role of Cytoskeleton (Microtubules, Microfilaments, Intermediate Filaments), Peroxisomes and Their Role in Detoxification

UNIT III CELL CYCLE AND REGULATION 09

Cell Cycle: Mitosis, Meiosis, Meiosis - Phases of Meiosis, Meiosis I, Meiosis II, regulations of cell cycle and check points and proteins involved in cell cycle check points. Basics in cell signaling-signaling molecules and receptors. Cell- Apoptosis and Necrosis, Mechanism of Apoptosis, Autophagy.

UNIT IV MOLECULES OF LIFE: PROTEINS- AMINO ACIDS AND FATS 09

Protein: Definition, properties, occurrence and biological importance of protein, Different levels of organization-Primary, secondary tertiary and Quaternary structures. Amino acids: Definition, composition, structure, properties, stability and biological importance of Amino Acid. Fats-Definition-Classification of lipids based on backbone structure, Chemistry and Characterization of lipids. Lipoproteins and Their Biological Role

UNIT V MOLECULES OF LIFE: CARBOHYDRATES AND NUCLEOTIDES 09

Introduction to carbohydrates-Monosaccharides, Disaccharides, Polysaccharides. Nucleic acids – Purines, pyrimidines, Nucleosides and Nucleotides. Types of Nucleic acids – DNA (deoxyribonucleic acid), RNA (Ribonucleic acid)

Total: 45 Hours

COURSE OUTCOMES:

CO-1: To Explain the structural organization of prokaryotic and eukaryotic cells, including plant, animal, bacterial cells, and viruses.

CO-2: To Explain the fluid mosaic model, membrane transport mechanisms, and functions of cell organelles.

CO-3: To Illustrate the stages of mitosis and meiosis, cell cycle checkpoints, and mechanisms of cell signaling and programmed cell death

CO-4: To Analyze the structure and function of proteins, their levels of organization, and their biological significance.

CO-5: To Explain the classification, structure, and function of lipids in biological systems.

CO-6: To Categorize monosaccharides, disaccharides, and polysaccharides, and their roles in cellular metabolism.

CO-7: To Differentiate between DNA and RNA, describe nucleotide structure, and explain the molecular basis of genetic information.

Textbooks:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2017). *Molecular Biology of the Cell* (6th Ed.). Garland Science.
2. Karp, G. (2019). *Cell and Molecular Biology: Concepts and Experiments* (8th Ed.). Wiley.
3. B. Miller (2023), *Introduction to Molecular Biology of Cell*, American Academic Publisher, USA.
4. K. Sathasivan (2023), *Introduction to Cell and Molecular Biology*, LT-Writing, USA.
5. T. Devasena (2024), *Biomolecules*, Independently Published, India.

Reference Books:

1. Cooper, G. M., & Hausman, R. E. (2022). *The Cell: A Molecular Approach* (8th Ed.). Sinauer Associates.
2. Lodish, H., Berk, A., Kaiser, C. A., & Krieger, M. (2021). *Molecular Cell Biology* (9th Ed.). W. H. Freeman.
3. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2021). *Principles of Biochemistry* (8th Ed.). W. H. Freeman.

WEB RESOURCE LINKS:

1. https://openstax.org/details/books/biology-2e/

24DBIA1_ **MATHEMATICS AND BIOSTATISTICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: To understand the key concepts of biostatistics and mathematics and use them to analyze biological data and draw the inferences for analyzed data. Students will learn to collect, analyze and interpret quantitative data, enabling them to make informed decisions and contribute to evidence-based research. The curriculum covers a wide range of topics, including descriptive statistics, probability theory, inferential statistics, regression analysis, and the use of statistical software.

UNITI NUMERICAL DESCRIPTIVE TECHNIQUES **12 hrs**

Numerical descriptive techniques: Measures of central tendency-mean, median, mode, Measure of dispersion-range and standard deviation

UNITII CORRELATION AND REGRESSION **12 hrs**

Correlation and Regression: correlation, correlation coefficient, properties of correlation coefficient, regression, properties of linear regression, rank correlation.

UNIT III PROBABILITYTHEORY **12 hrs**

Probability Theory: Classical and modern definition of probability, Sample space and events, independent events, mutually exclusive events, axioms of probability, conditional probability, additional and multiplication theorem of probability, Baye's theorem and related problems.

UNIT IV SAMPLING THEORY **12 hrs**

Sampling Theory: Objective of sampling, Sampling error, Methods of sampling, Sampling distribution, Sampling distribution of sample mean and sample proportion, Standard error.

UNITV PROBABILITY DISTRIBUTION **12 hrs**

Probability Distribution: Bernoulli's trial, Binomial distribution, Poisson distribution, Normal and Standard normal distribution, Uniform distribution

Total: 60 Hours

COURSE OUTCOMES:

CO1: To understand basic statistical concepts and their applications in biological research.

CO-2: To analyze and interpret data using descriptive and inferential statistical methods.

CO-3: To apply probability theory to assess risk and uncertainty in biological studies.

CO-4: Utilize statistical software to perform complex data analysis and modeling.

CO-5: Communicate statistical findings effectively to both Scientific and non-scientific audiences.

TEXT BOOK:

1. S.P. Gupta (2014), Statistical Methods, 44th Edition, Sultan Chand & Sons.

REFERENCE BOOKS:

1. P.R. Vittal and V. Malini (2007), Statistical and Numerical Methods, Margham Publications, Ist Edition.

2.S.C. Gupta and V.K. Kapoor (2001), Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition.

3.Beri G (2009), Business Statistics, Tata McGraw Hill Publishing Company Limited.

WEB RESOURCE LINKS:

1. https://www.khanacademy.org/math/statistics-probability
2. http://www.DukeBiostatisticsResourcesforNon-Statisticians.com
3. https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/resources/lecture-notes

L	T	P	O	C
4	0	0	2	4

24DBIA1_ **BIOPHYSICAL CHEMISTRY**

COURSE OBJECTIVE: The primary objectives are to explore the physical principles governing biological systems, understand the interactions between molecules at the molecular level, and apply quantitative methods to analyze biological processes. Through theoretical concepts and practical applications, students will delve into the thermodynamics, kinetics, and spectroscopic techniques relevant to biological macromolecules.

UNIT I WATER, ACIDS & BASES 12

Molecular structure, Association of Water molecules through H- bonding, Nature of hydrophobic interactions, Physico Chemical properties of Water, State of Water in biostructures & its significance. Acids and Bases, Mole & Normality, Weak acids, Amphoteric electrolytes, pH, Calculation of pH from H & OH Concentration, measurements of pH, Henderson Hasel batch equation, Titration curve & pK values, Buffers & Stability of their pH, Numerical problems.

UNIT II PROTEINS 12

Structural level of proteins & stabilizing forces, Conformational properties of polypeptides, Ramchandran plot, Helical parameters & Conformation, organization & interaction of angles, Conformational structure of alphakeratin, Silk fibrin, Collagen, Actin, Myosin, Folded conformation of globular proteins (e.g.- Haemoglobin, Myoglobin, Lysozyme, Cytrochromes) mechanism & side chain conformation, Classification & role of Betabends & bulges, Super secondary structure, Domain & motiffs, Proteins in solution & protein sequencing, Concept of protein evolution, Cytochrome & Haemoglobin evolutionary studies.

UNIT III NUCLEIC ACIDS 12

Double helical structure of DNA, Conformational parameters of Nucleic acids & their constituents, Chargff's rule, DNA polymorphism, DNA supercoiling, Hyperchromicity, Circular DNA, Types & structure of RNA, mRNA, rRNA, tRNA & modified nucleotides, nucleic acid sequencing.

UNIT IV OTHER BIOLOGICAL POLYMERS 12

Structure and conformation of polysaccharide cellulose, Amylase, Chitin, Carbohydrate conjugates, Classification & biological role of vitamins & hormones.

UNIT V MACROMOLECULAR INTERACTIONS 12

Ligand interaction at equilibrium, Identical independent sites, Scatchard plot, Multiple classes of independent sites, Interaction between binding sites, Allosterism, MWC model, Sequential model, Oxygen Hemoglobin binding, Binding of two different ligands, Energetics and dynamics of binding, Structures of protein- ligand complexes, Relationship between protein conformations and binding, Binding of Immunoglobulins and DNA binding proteins, Free radicals in biology and medicine.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Understand the fundamental principles of physical chemistry as applied to biological systems.

CO-2: Analyze the thermodynamic properties of biomolecules and their interactions.

CO-3: Apply kinetic and spectroscopic methods to investigate the dynamics and structure of biological macromolecules.

CO-4: Interpret experimental data and mathematical models to elucidate the behavior of biological systems.

CO-5: Demonstrate proficiency in utilizing biophysical techniques for studying complex biochemical processes.

TEXT BOOKS:

1. Charles R. Cantor and Paul R. Schimmel (2000), Biophysical Chemistry, 1st edition.
2. Kensal E. van Holde, W. Curtis Johnson, and P. Shing Ho (2018), Principles of Physical Biochemistry, 2nd edition.

REFERENCE BOOKS:

1. Ignacio Tinoco Jr., Kenneth Sauer, James C. Wang, and Joseph D. Puglisi (2013), Physical Chemistry: Principles and Applications in Biological Sciences, 5th edition.
2. Thomas E. Creighton (1992), Biophysical Chemistry: Part I: The Conformation of Biological Macromolecules, 1st edition

WEB RESOURCE LINKS:

1. https://www.springer.com/gp/chemistry/physical+chemistry?disciplineId=biophysical-chemistry&facet-content-type=books

24PBIA11 INTRODUCTION TO BIOINFORMATICS PRACTICAL I

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES: To understand various computational techniques employed to analyze biological data with the use of sequence information. Finally acquire skills to use different approaches for prediction of protein structure. This course also aims to provide students with a practical and hands-on experience with common bioinformatics tools and databases. Students will be trained in the basic theory and application of programs used for database searching, protein and DNA sequence analysis.

1.	Retrieval of DNA Sequence using Sequence Databases: NCBI	03
2.	Retrieval of DNA Sequence using Sequence Databases: DDBJ	03
3.	Retrieval of DNA Sequence using Sequence Databases: EMBL.	03
4.	Gene prediction using GenScan tool.	03
5.	Retrieval of Protein Sequence using Sequence Databases: UNIPROT	03
6.	Retrieval of 3D Protein Structure Using Protein Data Bank and AlphaFold DB.	03
7.	Sequence similarity searching (BLAST/DeepBlast).	03
8.	Sequence similarity searching (FASTA).	03
9.	Pairwise alignment – Global and Local Alignment	03
10.	3D structure Visualization tool (Rasmol & AlphaFold2)	03

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To learn how to retrieve the biological data from NCBI, DDBJ and EMBL databases.

CO-2: To analyze the genes coding and non-coding regions of sequence using Gene prediction tools.

CO-3: To acquire the knowledge of protein sequence and structure using databases.

CO-4: To learn the sequence similarity between the sequences and their alignment.

CO-5: To analyze 3D structure and their amino acids sequence using visualization tools.

TEXT BOOKS:

1. H. D. Ismail (2023), Bioinformatics: A Practical Guide to Next Generation Sequencing Data Analysis, Chapman & Hall/CRC Press, Boca Raton, FL, USA.

REFERENCE BOOKS:

2. Y. Hasija (2023), All About Bioinformatics: From Beginner to Expert, Academic Press, Elsevier, New Delhi, India.
3. T. Dandekar and M. Kunz (2023), Bioinformatics: An Introductory Textbook, Springer Nature, Cham, Switzerland.

WEB RESOURCE LINKS

1. Interdisciplinary Tutorial Resources

L	T	P	O	C
1	0	0	1	1

24DVAC11 **UNIVERSAL HUMAN VALUES**

COURSE OBJECTIVE:

The candidates will be able to appreciate the complementarity between the values and skills for sustained happiness and prosperity. To influence the students to approach the life and profession with a holistic perspective towards a value-based living in a natural way. To highlight plausible implications of holistic understanding of ethical human conduct.

UNIT- I INTRODUCTION TO VALUE EDUCATION 5

Living a fulfilling life. Value education. Skill education. Complementarity of Values and Skills. Development of a holistic perspective. Right understanding, relationship and physical facility. Understanding the happiness and prosperity.

UNIT-II HARMONY AT MULTIPLE LEVELS 5

Human being as co-existence of the self and the human body. Understanding harmony in the self. Harmony in the family and understanding values in human-human relationships. Harmony in the society and understanding universal human order. Harmony in nature and understanding the interconnectedness, self-regulation and mutual fulfillment. Harmony in existence and understanding co-existence at various levels.

UNIT-III IMPLICATIONS OF THE RIGHT UNDERSTANDING 5

Ethical human conduct. Implications of value-based living. Right understanding of professional ethics. Humanistic education. Holistic technologies, production systems and management models. Strategies for transition towards value-based life and profession.

Total: 15 Hours

COURSE OUTCOMES:

At the end of the course learners will be able to:

CO1: Develop qualities like responsibility and the ability to handle problems with sustainable solutions.

CO2: Appraise human values and the harmony at various levels.

CO3: Perceive a better critical ability.

CO4: Develop qualities pertaining to value-based living.

CO5: Apply what they have learnt to their own self in real life settings.

TEXT BOOKS:

1. R.R. Gaur, R. Asthana, G.P. Bagaria. (2023). A Foundation Course in Human Values and Professional Ethics. 3rd Revised Edition. Excel Books, New Delhi.

REFERENCE BOOKS:

1. Nagaraj, Jeevan Vidya Prakashan, Amar Kantak. Jeevan Vidya: Ek Parichaya . (1999).
2. Rakesh Gupta. (2008). Jeevan Vidya: An Introduction (Introductory Book to Madhyasth Darshan-Coexistentialism). English Version.
3. N. Tripathi. (2004). Human Values. First Edition. New Age International Publishers, New Delhi.

24SSKU11 **SOFT SKILLS I**

L	T	P	O	C
2	0	0	1	2

Course Objectives

- To learn and apply basic etiquette for personal and corporate interactions.
- To develop stress management and resilience techniques for high-pressure work environments.
- To enhance self-awareness and personal branding for career growth.
- To master 21st-century skills with an emphasis on digital fluency and AI collaboration.

UNIT-I: INTRODUCTION TO SOFT SKILLS 06

- Hard Skills and Transferable Soft Skills.
- The 15 Power Skills: High-demand workplace competencies (Agility, Negotiation, Networking).
- Professional Communication: Basics of Workplace Verbal and Written Communication.
- Time Management: Leveraging the Eisenhower Matrix for professional productivity.

UNIT-II: 21st CENTURY & DIGITAL SKILLS *06*

- Cognitive Flexibility: Lateral Thinking & Left Brain/Right Brain functionality.
- Problem-Solving: Structured approaches to real-world business challenges.
- Digital Literacy: Introduction to AI Tools for workplace efficiency and ethical usage.
- Data Literacy: Understanding the importance of information in decision-making.

UNIT-III: SELF-AWARENESS & PERSONAL BRANDING 06

- Core Identity: Human Values and Professional Ethics.
- Strategic Self-Analysis: SWOT Analysis applied to Career Planning.
- Execution Framework: The PDCA (Plan-Do-Check-Act) approach to continuous improvement.
- Personal Branding: Optimizing your professional digital footprint (LinkedIn).

UNIT-IV: CRITICAL THINKING & INTERVIEW READINESS 06

- Thought Leadership: Six Thinking Hats for collaborative decision-making.
- Critical Thinking: Identifying biases and logical fallacies in workplace data.
- The STAR Method: Structuring responses (Situation, Task, Action, Result) for

behavioural interviews.

- Active Open-Mindedness: Cultivating adaptability in a diverse workforce.

UNIT-V: PROFESSIONAL CONDUCT & WELL-BEING 06

- Corporate Etiquette: Meeting protocols, email hygiene, and professional grooming.
- Stress Management: Meaning of Eustress vs. Distress; the "Stress Bucket" model.
- Workplace Resilience: Strategies for managing feedback, rejection, and burnout.
- Holistic Health: Impact of sleep and nutrition on professional performance.

Total: 30 Hours

COURSE OUTCOMES (COS)

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

- CO1: Demonstrate professional etiquette and digital netiquette in corporate settings.
- CO2: Apply stress management and resilience strategies to maintain productivity.
- CO3: Utilize SWOT and PDCA tools to manage personal career growth.
- CO4: Leverage AI and digital tools to enhance 21st-century workplace efficiency.
- CO5: Solve complex problems using the STAR method and critical thinking framework

TEXT BOOKS:

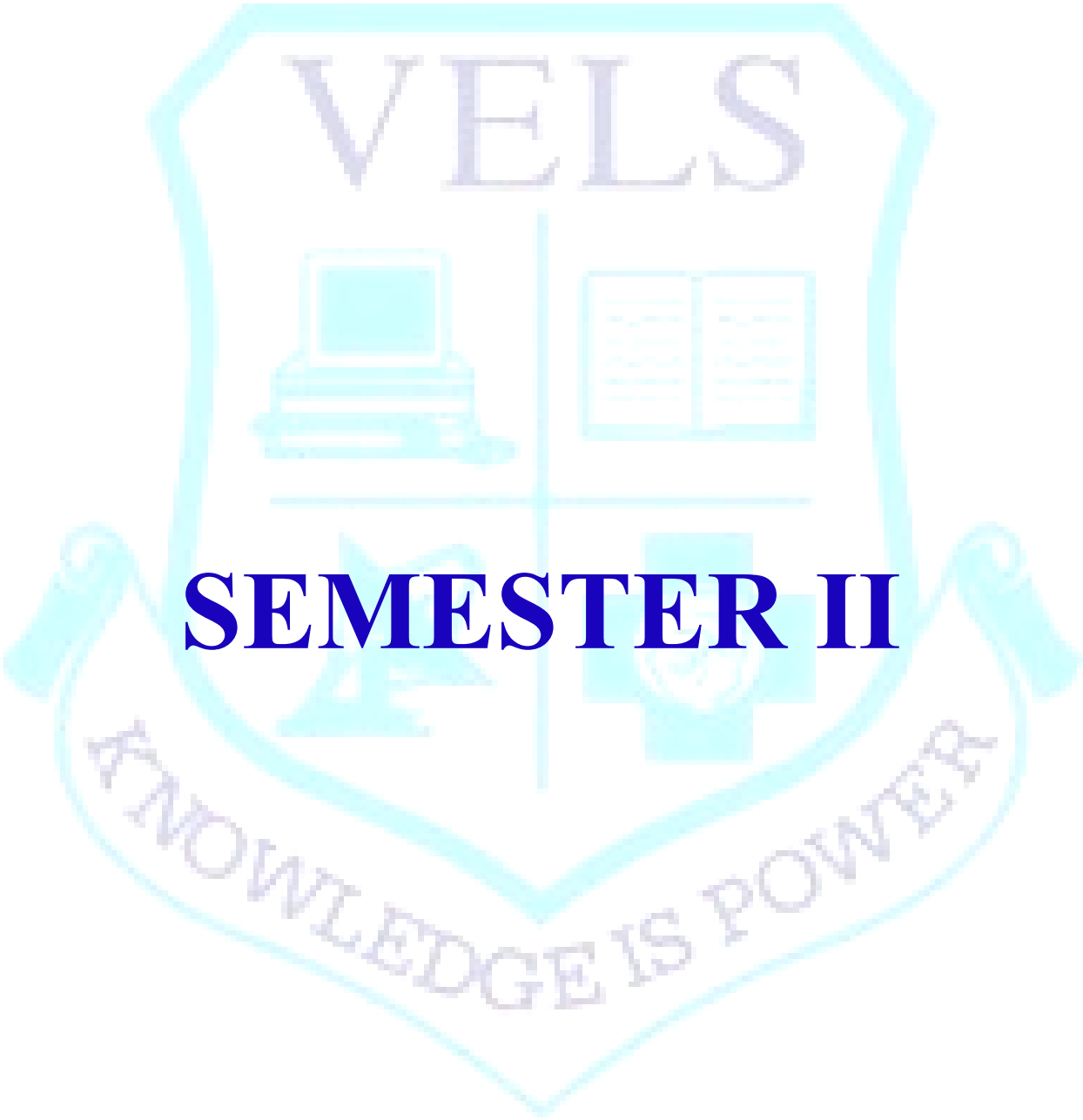
- Rao, M. S. 21st Century Skills: Learning for Life in Our Times. Notion Press, 2023.
- Goleman, Daniel. Emotional Intelligence: Why It Can Matter More Than IQ. Updated ed., Bloomsbury, 2020.
- Duhigg, Charles. Smarter Faster Better: The Secrets of Being Productive in Life and Business. Random House, 2021.
- Carnegie, Dale. How to Win Friends and Influence People. Updated ed., Simon & Schuster, 2022.
- Kawamoto, Dawn, and others. Digital Literacy in the 21st Century. Routledge, 2022.

REFERENCE BOOKS:

- Trilling, Bernie, and Charles Fadel. 21st Century Skills: Learning for Life in Our Times. Jossey-Bass, 2021.
- Newport, Cal. Digital Minimalism: Choosing a Focused Life in a Noisy World. Portfolio, 2019.
- Covey, Stephen R. The 7 Habits of Highly Effective People. Simon & Schuster, 2020.
- Harvard Business Review. HBR Guide to Managing Stress at Work. Harvard Business Review Press, 2021.

WEBSITES

- LinkedIn Learning. LinkedIn Corporation, https://www.linkedin.com/learning/.
- MindTools. Mind Tools Ltd., https://www.mindtools.com/.
- Harvard Business Review. Harvard University, https://hbr.org/.



SEMESTER II

L	T	P	O	C
2	0	0	1	2

24LTAM21 காப்பியம், பக்தி இலக்கியம், கலைகள், நாகரிகம்-பண்பாடு

பருவம்-2, தமிழ்மொழிப்பாடம்-2, பகுதி-1, தகுதிப்புள்ளி: 2, வாரப் பாட நேரம்: 2.
தாள்-2

பாடத்திட்ட நோக்கம்:

மாணவர்களின் இலக்கிய நாட்டத்தை மேம்படுத்துதல், அற இலக்கியங்கள், சிற்றிலக்கியம், சிறுகதை ஆகியவற்றை அறிமுகப்படுத்துதல், தற்காலப் பேச்சுத் தமிழ் எழுத்துத்தமிழ் ஆகியவற்றின் வளர்நிலைகளை மாணவர்களை அறியச் செய்தல், அதன்வழி சிந்தனை வளத்தைப் பெருகச் செய்தல் என்பனவும் மேற்கண்டவழி மாணவர்களை ஆளுமை மிக்கவர்களாக உருவாக்கி, போட்டித்தேர்வுகளுக்குத் தயார் செய்து அவர்களின் மொழித் திறனை மேம்படுத்த அவர்களுக்குக் கடிதம் எழுதும் கலையைக் கற்றுக்கொடுத்தல், அணி இலக்கணத்தை அறியச் செய்தல் என்பன இந்தப் பாடத்திட்டத்தின் முக்கிய நோக்கமாகும்.

அலகு 1 காப்பியங்கள் 8மணி நேரம்

சிலப்பதிகாரம்- கனாத்திறம் உரைத்தக் காதை முழுவதும்.
மணிமேகலை- மலர்வனம் புக்க காதை முழுவதும்.
கம்பராமாயணம் - குகப் படலம் (தேர்ந்தெடுக்கப்பட்ட ஒன்பது பாடல்கள்)

அலகு 2: பக்தி இலக்கியம் 8மணிநேரம்

1. மாணிக்கவாசகர் - திருவாசகம் – மூன்று பாடல்கள்
   - ✓ புல்லாகி பூடாகி (சிவபுராணம்)
   - ✓ எல்லாப் பிறப்பும் (சிவபுராணம்)
   - ✓ உற்றாரை யான் வேண்டேன் (திருப்புலம்பல்)
2. ஆண்டாள் - திருப்பாவை – மூன்று பாடல்கள் (1, 3, 4)
   - ✓ மார்கழித் திங்கள் ... (பாசுரம் 1)

- ✓ ஓங்கி உலகளந்த... (பாசுரம் 3)
- ✓ ஆழிமழைக் கண்ணா... (பாசுரம் 4)

3. வீரமாமுனிவர் - தேம்பாவணி – வளன் சனித்தப் படலம்
4. சீறாப்புராணம்- மானுக்கு பிணை நின்ற படலம்

அலகு 3 கலைகள் 7 மணி நேரம்

சிற்பம் - ஓவியம் - இசை - கூத்து - ஒப்பனை - ஆடை அணிகலன்கள்.

அலகு 4 நாகரிகம், பண்பாடு 7மணி நேரம்

சொற்பொருள் விளக்கம் - பண்டைத் தமிழர் வாழ்வியல் - அகம் - களவு - கற்பு - குடும்பம் - விருந்தோம்பல் - உறவு முறைகள் - சடங்குகள் - நம்பிக்கைகள் - பொழுதுபோக்கு - புறம் - போர் முறைகள் - நடுகல் வழிபாடு - கொடைப்பண்பு.

மொத்தம்: 30 மணி நேரம்

பார்வை நூல்கள்

1. டாக்டர் அ. தட்சிணாமூர்த்தி (2001), **தமிழர் நாகரிகமும் பண்பாடும்,** ஐந்திணைப் பதிப்பகம்,.
2. மா. நன்னன் **(**1999), **தவறின்றித் தமிழ் எழுதுவோம்,** ஏகம் பதிப்பகம்,.
3. மருதூர் அரங்கராசன் (2003), **தவறின்றித் தமிழ் எழுத** -, ஐந்திணைப் பதிப்பகம்.
4. வரதராசன், மு (2002), **தமிழ் இலக்கிய வரலாறு** புது தில்லி : சாகித்திய அக்காதெம,.
5. நீல. பத்மநாபன், சிற்பி பாலசுப்ரமணியம் (2007), **புதிய தமிழ் இலக்கிய வரலாறு**, சாகித்திய அகாடெமி, .
6. முனைவர் மறைமலை இலக்குவனார், **செம்மொழி தமிழின் சிறப்பியல்புகள்** -; https://www.youtube.com/watch?v=HHZnmJb4jSY
7. **பாடநூல் தேடலுக்கான இணையம் -** https://archive.org/

24LHIN21 **वर्ष I - सत्र II (गद्य, पत्र लेखन & व्यावहारिक हिन्दी)**

L	T	P	O	C
2	0	0	1	2

I Year-Sem II (Prose, Official Letter Writing & Functional Hindi)

COURSE OBJECTIVES:

- To inculcate the human values, importance of patriotism and hard work
- To train students in functional Hindi
- To introduce the usage of Inscript keyboard

UNIT I: मुंशी प्रेमचंद कृत 'बूढी काकी '(कहानी)
'Boodee kaki" (Kahani) by Munshi Premchand 6hrs.

UNIT II: जयशंकर प्रसाद कृत 'पुरस्कार' (कहानी)
'Puraskar' (Kahani) by Jaishankar Prasad 6hrs.

UNIT III: हरिशंकर परसाई कृत 'मैं नरक से बोल रहा हूँ' (व्यंग्य)
'Main Narak Se Bhol Raha Hun' (Vyangy) by Harishankar Parsayi, 6hrs.

UNIT IV: व्यावहारिक हिन्दी 1 – 50 – तकनीकि शब्द, 50 – पदनाम व विभागीय नाम, भाव एक भाषा अनेक 6hrs.
Functional Hindi 1 - 50-Technical Words, 50-Designation & Department Names, Bhav Ek Bhasha Anek

UNIT V: व्यावहारिक हिन्दी 2 – पत्र लेखन – 3 औपचारिक पत्र, इन्स्क्रिप्ट कीबोर्ड का परिचय 6hrs.
Functional Hindi 2 -Letter Writing- 3 Official Letters. Introduction to Inscript Keyboard

Total: 30hrs

COURSE OUTCOMES:

At the end of this course Students will be able to

CO1 Know to the human values

CO2 Know the importance of patriotism

CO3 Know the value of hard work in human life

CO4 Journalize in Functional Hindi

CO5 Use in script keyboard

TEXT BOOK:

1. Ed. Subhash chandar, Boodi Kaki by Premchand (2012), Natioonal Book Trust.
2. Jaishankar Prasad, Pratinidhi Kahaniyan, Raj Kamal Prakashan (2015).
3. Harishankar Parsai, Pratinidhi vyangy, Rajkamal, (2007).
4. Kendriya Hindi Prashikshan Sansthan, Parangat, Bharat Sarkar (2015).

REFERENCE BOOK:

1. Kendriya Hindi Sansthan, Banking Hindi Patyakram, (2012).

WEBLINK:

1. Munshi Premchand, Manasarovar, 2007, http://gadyakosh.org
2. Jaishankar Prasad/ http://gadyakosh.org
3. Harishankar Parsai/ https://hindikahani.hindi-kavita.com
4. rayojanmoolak Hindi: https://hi.mwikipedia.org
5. https://rajbhasha.gov.in/en/introduction

COURSE OBJECTIVES:

L	T	P	O	C
2	0	0	1	2

The lessons are being chosen:

- to express his / her where abouts and to ask seek direction
- to express obligation and restriction
- to describe a place
- to narrate and to question
- to describe someone
- to express his desire and to speak about the futur

UNITS:

UNIT 1 C'est où 5 hours

hoursL'impératif, Les articles contractés au, à la…, Le passé composé et l'accord du participe passé avec être.

UNIT 2 N'oubliez pas 5 hours

Le pronom relatif Qui, que, où, Les pronoms compléments indirects (me, te, lui, leur…)

UNIT 3Belle vue sur la mer --

Les adjectifs démonstratifs, Y- pronom complément. 4 hours

UNIT 4 Quel beau voyage!

Les verbes pronominaux, En- pronom complément. 4 hours

UNIT 5joli

L'imparfait, L'imparfait ou le passé composé. 5 hours

UNIT 6 Et après?

Le futur simple, Le subjonctif présent. 7 hours

Total hours- 30 hours

COURSE OUTCOMES

- The students would be able to express his/her where about and to ask direction
- The students would be able to express obligation and restriction
- The students would be able to describe a place
- The students would be able to narrate and to question
- The students would be able to describe someone
- The students would be able to express his desire and to speak about the futur

TEXT / REFERENCE BOOK:

Prescribed book: LATITUDES 1 (A1/A2) MÉTHODE DE FRANÇAIS - Régine Mérieux and Yves Loiseau

Reference book: SAISON A1 - MÉTHODE DE FRANÇAIS - Marie-Noëlle Cocton, Élodie Heu, Catherine Houssa, Émilie Kasazia

24LENG21 **ENGLISH – II**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To develop understanding of advanced grammar
- To build ability to construct accurate, meaningful sentences, questions & responses.
- To introduce key literary genres: prose, poetry, and fiction.
- To improve reading, comprehension, and interpretation skills.
- To strengthen effective written and spoken communication.

UNIT-I GRAMMAR 6

- Phrases & Clauses, Simple, Compound & Complex Sentences,
- Conditions Clauses, Direct & Indirect Speech, Degrees of Comparison

UNIT-II GRAMMAR 6

- Framing Questions (Open/Closed Questions), Short answers, Question Tags
- Active & Passive Voice, Sentence Pattern, Transformation of Sentences

UNIT-III PROSE 6

- If you are Wrong, admit it-Dale Carnegie
- Words of Wisdom- Chetan Bhaghat

UNIT-IV POETRY 6

- La Belle Dame Sans Merci - John Keats
- Ozymandias-P.B.Shelley

UNIT-V FICTION 6

- The School for Empathy E.V. Lucas
- The Lamb to the Slaughter-Roald Dahl

Total: 30 hours

COURSE OUTCOMES

After completing the course, students will be able to:

CO1: demonstrate a clear understanding of grammar structures, including clauses, sentence patterns, and degrees of comparison.

CO2: Frame questions and appropriate responses using correct grammatical forms.

CO3: Apply grammatical knowledge in speaking and writing with accuracy.

CO4: Read and analyze prose, poetry, and fiction, identifying themes and ideas.

CO5: Express ideas clearly and confidently in academic and everyday communication.

TEXT BOOKS:

- Dale Carnegie. “If You Are Wrong, Admit It.” In How to Win Friends and Influence People, Simon & Schuster, 1936.
- Chetan Bhagat. “Words of Wisdom.” In What Young India Wants, Rupa Publications, 2012.
- John Keats. “La Belle Dame Sans Merci.” In The Complete Poems of John Keats, Modern Library, 2001.
- Percy Bysshe Shelley. “Ozymandias.” In The Complete Poems of Shelley, Oxford University Press, 2002.
- E. V. Lucas. “The School for Sympathy (Empathy).” In A Lucas Omnibus, Methuen, 1953.
- Roald Dahl. “Lamb to the Slaughter.” In Someone Like You, Alfred A. Knopf, 1953.

REFERENCE BOOKS:

- Murphy, Raymond. English Grammar in Use. 5th ed., Cambridge University Press, 2019.
- Swan, Michael. Practical English Usage. 4th ed., Oxford University Press, 2016.
- Wren, P. C., and H. Martin. High School English Grammar and Composition. Revised ed., S. Chand & Company Ltd., 2015.

WEBSITES:

- https://learnenglish.britishcouncil.org/free-resources/grammar
- https://www.perfect-english-grammar.com/
- https://www.usingenglish.com/

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L	T	P	O	C
3	0	0	2	3

24CBIA21 **PROGRAMMING IN C++**

COURSE OBJECTIVES: To provide the clear concepts on programming methodology. To make the students understand the various programming concepts in C language and to make clear understanding on C applications and make use of C programming for various calculation methods.

UNIT I PRINCIPLES OF C++ 09

Object-Oriented Programming (OOP) – Introduction to OOP principles – Key concepts – Class and Object fundamentals – Data abstraction, Encapsulation, and Modularity – Inheritance: Types and Implementation – Polymorphism: Compile-time and Runtime – Dynamic Method Dispatch and Message Passing – Comparison of Object-Oriented Languages – Real-world Applications of OOP in Software Development.

UNIT II INTRODUCTION TO C++ 09

Introduction to C++ – History – Applications – Procedure-Oriented Programming – Object Oriented Programming versus Procedure-Oriented Programming – Structure of C++ Program – Comparison between C and C++.

UNIT III BASICS OF C++ 09

Tokens, expressions, keywords, Identifiers, constants, Operators, Data types – Standard input and output statements – Use of << and >> operators – Declaration of variables – Sample Programs – C++ programs to compute Temperature conversion, pH, BMI, RCF, rpm and Average Mol. Wt. of DNA.

UNIT IV CONTROL STATEMENTS AND FUNCTIONS 09

Branching statements – if and switch statements– looping statements – while, do-while and for statements – goto statement – sample programs – Functions, Function prototype – Inline Functions – Default arguments – Function overloading – Sample Programs.

UNIT V CLASSES AND OBJECTS 09

Creating a class – Defining member functions – Creating objects – Accessing class member Arrays within a class – Arrays of objects – Friend function – Local classes – Constructors and Destructors-Sample Programs demonstrating class usage.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: To adapt the fundamentals of C++ programming

CO-2: To utilize the concepts of operators and in build functions in C++ programming

CO-3: To utilize the C++ programming control structures and decision-making concepts

CO-4: To design the array, structure and unions in the programming

CO-5: To design the pointers and files in the programming

CO-6: To implement object-oriented programming concepts such as classes, objects, and inheritance.

CO-7: To develop real-time applications using C++ with an emphasis on problem-solving and optimization techniques.

TEXT BOOKS:

1. E. Balagurusamy (2015), Programming in ANSI C, 6th Edition, Tata Mc-Graw Hill.

REFERENCE BOOKS:

1. Kanetkar Y (1999), Let us C, BPB Publication, New Delhi.
2. H. Schildt, C (2000), The Complete Reference, 4th Edition, TMH Edition.
3. Ashok N. Kamthane (2006), Programming with ANSI and Turbo C, Pearson Education.

WEB RESOURCE LINKS:

1. LearnCpp.com
2. freeCodeCamp.com

24CBIA22 BIOOGICAL DATABASES AND SEQUENCE ANALYSIS

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: To understand and appreciate the need and significance of sequence analysis and the bioinformatics approaches, algorithms for sequence analysis, the application of methods for analysis of the biomolecular sequence data.

UNIT I BIOINFORMATICS AND DATABASES 09

Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. Data quality checks and anomaly detection in large bioinformatics datasets using Artificial Intelligence.

UNIT II SEQUENCES DATABASES AND STRUCTURAL DATABASE 09

General Introduction of Biological Databases and its classification. Types of databases, Sequences Databases: Nucleotide Sequence databases, Protein sequence databases, Structural Database, Information Retrieval System: Entrez and SRS, Structural File format- Natural Language Processing: PubTator 3.0 and BioBERT.

UNIT III DATA SUBMISSION TOOL AND ANALYSIS TOOLS 09

Data Submission Tool: Nucleotide sequence submission tools, Protein submission tools, command line tools for Genbank. Sequence Analysis Tools: Nucleotide and Protein sequence analysis. Machine Learning algorithms for classification of gene expression data-Scikit.

UNIT IV PREDICTION TOOLS AND MODELLING TOOLS 09

Prediction Tools: Phylogenetic Trees and phylogenetic analysis - Phylip, Phyml. Gene Prediction – Genscan, GrailEXP. Protein structure and Function Prediction – Prosite, 3DPSSM. Modelling Tools: Tools for 2D protein modelling –Tools for 3D protein modelling Deep Viewer. Deep learning-based tools for 3D modeling: RosettaFold, AlphaFold2.

UNIT V MOTIF AND DOMAIN 09

Motif and Domain: Motif databases and analysis tools. Domain databases (CDD, SMART, ProDom) and Analysis tools, Multiple alignment (Clustal W, Clustal Omega, T-Coffee, Muscle), Artificial Intelligence-enhanced algorithms for multiple sequence alignment-DeepMSA.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: To adapt the fundamentals of Bioinformatics databases and information retrieval systems.

CO-2: To acquire the concepts of sequence databases and structure databases.

CO-3: To learn how to submit the biological data to the sequence databases.

CO-4: To design the evolutionary relationship using trees and Functional prediction of protein structures

CO-5: To Examine the motif and domain regions in the protein sequence using databases.

CO-6: Utilize computational tools and web servers for sequence analysis and data interpretation.

CO-7: Analyze Next-Generation Sequencing (NGS) data and its applications in genomics and transcriptomics.

TEXT BOOKS:

1. Orpita Bosu, Simminder kaur Thukral (2007), "Bioinformatics-Databases Tools and Algorithms", Oxford University Press.

REFERENCE BOOKS:

1. D. Higgins and W. Taylor. (Eds) (2008), "Bioinformatics: Sequences, Structures and databanks", Oxford University Press, Oxford, UK.
2. N. Gautham (2006), "Bioinformatics", Narosa Publishing Company, New Delhi.
3. V.R. Srinivas (2005), "Bioinformatics: Sequences and genomics analysis", Cold SpringHarbor Laboratory press, Cold Spring harbor, USA.

WEB RESOURCE LINKS:

1. https://www.ncbi.nlm.nih.gov/guide/all/

L	T	P	O	C
3	0	0	2	3

24MBIA21 **IMMUNOLOGY AND MICROBIOLOGY**

COURSE OBJECTIVES: To find the mechanisms of immune response, pathogen-host interactions, and the role of microbes in health and disease. The course will emphasize both theoretical knowledge and practical skills, enabling students to perform essential laboratory techniques and critically analyze scientific literature.

UNIT I INTRODUCTION TO MICROBIOLOGY AND MICROSCOPY 09

Definition-History and scope of microbiology. Study of Microbial structure-Cell cycle and reproduction of bacteria. Microscopy–principles of microscopy-bright-field microscopy–Simple microscope, Compound microscope.

UNIT II STERILIZATION AND STAINING TECHNIQUES 09

Sterilization – dry and moist heat - pasteurization – tyndallization – radiation – ultrasonication, filtration-membrane filters, depth filters; centrifugation; radiation. Physical and Chemical method of Sterilization. Definition-Staining-– Classification of stains-Types of Staining-simple staining-Differential Staining-Mechanism of gram staining – acid fast staining, negative staining, capsule staining, flagella staining, endospore staining

UNIT III ORGANS AND CELLS OF IMMUNE SYSTEM 09

Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic Cell-Primary lymphoid organs-Secondary lymphoid organs and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT. Differentiation and maturation of T cell and B cell, Immune Responses-Innate and Acquired immunity- Humoral and Cell mediated Immunities- Primary and Secondary Immune responses.

UNIT IV ANTIGEN, ANTIBODIES AND MHC MOLECULES 09

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants, TCR and BCR, Structure, Types, Functions and Properties of Immunoglobulins; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies. MHC- Class I and Class II MHC molecule- Antigen processing and presentation.

UNIT V VACCINE PRODUCTION AND IMMUNOTECHNIQUES 09

Production of Monoclonal and Polyclonal Antibodies-Active and Passive Immunization, Vaccines-Killed-Attenuated and Recombinant Vaccine, Immunotechniques- Antigen-Antibody Reaction, Precipitation Reaction-Immunodiffusion, Immunoelectrophoresis, Agglutination Reaction- Blood grouping, Haemagglutination, Assay- ELISA, Radioimmunoassay, Immunoblotting.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: To Understand fundamental principles of immunology, including the structure and functions

CO-2: To Identify and classify various microorganisms, understanding their physiology, genetics.

CO-3: To Develop proficiency in laboratory techniques used in immunology and microbiology.

CO-4: To Research studies in immunology and microbiology, synthesizing information to understand and discover current trends and advancements in the field.

CO-5: To Apply knowledge of immunology and microbiology in clinical, research, and public health contexts.

CO6**:** Evaluate different types of vaccines, including their mechanisms and applications in immunization.

CO7**:** Apply immune techniques such as ELISA, immunodiffusion, and immunoblotting for diagnostic and research purposes.

TEXT BOOKS:

1. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A. Owen, Kuby (1998), Immunology, 8th Edition.
2. M. T. Madigan and K. S. Bender (2023), *Brock Biology of Microorganisms*, 16th Edition, Pearson Education, Boston, MA, USA.

REFERENCE BOOKS:

1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. Roitt's (2017) Essential Immunology, 13th Edition.
2. S. Stranford, J. Owen, J. Punt, and P. Jones (2023), *Kuby Immunology: COVID-19 & Digital Update*, 8th Edition, Macmillan Learning, New York, NY, USA.

WEB RESOURCE LINK:

1. **https://onlinelibrary.wiley.com/journal/13652567**

24DBIA2_ MOLECULAR BIOLOGY

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES:

The course on Molecular Biology aims to provide a comprehensive understanding of the molecular mechanisms that govern cellular processes and genetic information flow. Students will explore the structure and function of nucleic acids and proteins, delving into the principles of DNA replication, transcription, and translation.

UNIT I NUCLEIC ACIDS – AN INTRODUCTION 12

Evolution of genetic material – Identification of genetic material – Chemistry of nucleic acids – Structure – types of DNA and RNA, Organization –prokaryotic and eukaryotic DNA, Mitochondrial and Chloroplast DNA, Griffith, Avery, Hershey and Chase experiments, RNA as genetic material, Epigenetic modifications. (DNA Methylation, Histone modifications).

UNIT II DNA REPLICATION AND REPAIR 12

DNA replication: Meselson –Stahl experiment, Molecular mechanisms of DNA Replication – bidirectional replication – Differences in prokaryotic and eukaryotic replication, Enzymes of DNA replication, DNA repair – mechanism of excision repair, SOS repair and mismatch repair. Telomeres and telomerase function.

UNIT III TRANSCRIPTION 12

Transcription process – Prokaryotic and Eukaryotic, RNA polymerase structure and function. Regulatory signal elements – features of promoters and enhancers, transcription factors, ribozymes – Post transcriptional modification of RNAs, Alternative splicing.

UNIT IV TRANSLATION 12

Genetic Code – Wobble hypothesis – Translation – ribosomes and tRNAs, Mechanism and regulation of protein synthesis – Post Translational modification of proteins.

UNIT V GENE REGULATION 12

Concept of gene: Genetic fine structure – cistron, muton and recon – exons and introns, Gene Regulation in Prokaryotes: Types of gene regulation, Operon concept – Lac and Trp operons – Gene regulation in eukaryotes – Downstream regulation. Gene Editing Technologies: CRISPR-Cas9:

Mechanism, applications in medicine and biotechnology, ZFNs and TALENs: Mechanism, advantages, and limitations.

Total: 60 Hours

COURSE OUTCOMES:

CO1: Explain the structure, types, and organization of nucleic acids in prokaryotes and eukaryotes.

CO2: Describe the molecular mechanisms of DNA replication and repair process.

CO3: Illustrate the transcription process, regulatory elements, and post-transcriptional modifications.

CO4: Explain the genetic code, translation mechanism, and post-translational modifications

CO5: Analyze gene regulation in prokaryotes and eukaryotes through operon models and downstream regulation.

CO6: Discuss epigenetic modifications and their role in gene expression regulation.

CO7: Evaluate gene editing technologies and their applications in molecular biology and medicine.

TEXT BOOKS:

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2017). Molecular Biology of the Gene (7th Edition). Pearson Education.
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., & Amon, A. (2021). Molecular Cell Biology (9th Edition). W. H. Freeman.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2022). Molecular Biology of the Cell (7th Edition). Garland Science.

REFERENCE BOOKS:

1. Karp, G. (2018). Cell and Molecular Biology: Concepts and Experiments (8th Edition). Wiley.
2. Bruce Alberts & Alexander Johnson (2015). Essential Cell Biology (4th Edition). Garland Science.
3. David L. Nelson & Michael M. Cox (2021). Lehninger Principles of Biochemistry (8th Edition). W. H. Freeman.
4. Primrose, S.B., & Twyman, R.M. (2019). Principles of Gene Manipulation and Genomics (8th Edition). Wiley-Blackwell.
5. B. Alberts, K. Hopkin, A. Johnson, D. Morgan, M. Raff, K. Roberts, and P. Walter (2024), Molecular Biology of the Cell, 7th Edition, W. W. Norton & Company, New York, NY, USA.

WEB RESOURCE LINKS

1. http://www.cellbiol.com/education.php

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

24DBIA2_ **WEB PROGRAMMING**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: The World Wide Web continues to provide a foundation for the development of a broad range of increasingly influential and strategic technologies, supporting a large variety of applications and services, both in the private and public sectors. There is a growing need for management and decision makers to gain a clearer understanding of the application development process, from planning through to deployment and maintenance.

UNIT I INTRODUCTION TO PHP AND BASIC CONCEPTS 12

Introduction to PHP, variables, data types, arrays, strings, operations, expressions, control structures, functions, reading data from web form controls like Text Boxes, radio buttons, lists etc., File Uploads, connecting to database, executing queries, handling results, Handling sessions and cookies. File Handling in PHP, listing directories.

UNIT II JAVASCRIPT BASICS AND INTRODUCTION TO AJAX 12

Introduction to JavaScript, JavaScript language –syntax, declaring variables, scope of variables functions, event handlers, Document Object Model, Form validations. Simple AJAX applications.

UNIT III XML AND DATA PARSING IN JAVA 12

Introduction to XML, Defining XML tags, tree, attributes and values, Document type definition, XML Schemas, Document Object model, XHTML Parsing XML Data - DOM and SAX parsers in java

UNIT IV SERVLETS AND WEB PROGRAMMING 12

Common Gateway Interface (CGI), Lifecycle of a Servlets, deploying a Servlets, The Servlets API, Reading Servlets parameters, reading initialization parameters, Handling Http Request & Responses, Using Cookies and sessions, connecting to a database using JDBC.

UNIT V JSP ESSENTIALS: BASICS TO DATABASE CONNECTIVITY 12

Introduction to JSP, The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session tracking, connecting to database in JSP.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Create web pages using PHP

CO-2: Identify the difference between the HTML PHP and XML documents. CO-3: Identify the engineering structural design of XML and parse tree

CO-4: Analyse the difference between and PHP and XML.

CO-5: Understand the concept of JAVA SCRIPTS.

TEXT BOOKS:

1. Web, Uttam K Roy, (2024) Oxford University Press
2. The Complete Reference PHP (2024) Steven Holzner, Tata McGraw-Hill

REFERENCE BOOKS:

1. Web Programming, building internet applications (2018) Chris Bates 2nd edition, Wiley Dremtech
2. Java Server Pages – Hans Bergsten, SPD O'Reilly
3. Java Script, D. Flanagan, O'Reilly, SPD.
4. Beginning Web Programming-Jon Duckett WROX.
5. Programming world wide web, R.W. Sebesta. Fourth Edition, Pearson.
6. Internet and World Wide Web – How to program, Dietel and Nieto, Pearson.

WEB RESOURCE LINK:

1. https://developer.mozilla.org/en-US/docs/Web
2. https://www.gutenberg.org/

24PBIA21 **PROGRAMMING IN C++ PRACTICAL II**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES: To provide the clear concepts on programming methodology. To make the students to understand the various programming concepts in C language and to make clearly understand on C applications and make use of c programming for various calculation methods.

1. a) Covert Centigrade scale to Fahrenheit scale. 03

   b) Convert Fahrenheit Scale to Centigrade scale.

2. Calculate Body Mass Index (BMI) value. 03

3. Calculate Average Molecular Weight of DNA. 03

4. Calculate Average of Two Numbers. 03

a) Find the biggest of three given numbers using if-else statement.
b) Compute the nature of the solution based on the pH value using switch–case statement

5. a) Find the sum of n natural numbers using while. 03

   b) Find the sum of n natural numbers using for statement.

6. Compute multiplication & Division of two numbers using inline functions. 03

7. Compute Simple Interest using Default Arguments. 03

8. Compute Volume of Cube, Cylinder & Rectangular Box using function overloading. 03

9. Display the Item Number and Cost using Classes & Objects. 03

10. Compute the Mean Value using friend function. 03

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To adapt the fundamentals of C programming using simple programs.

CO-2: To acquire the knowledge of if and nested if control loops.

CO-3: To utilize the control structures and decision-making concepts

CO-4: To design the array, structure and unions in the programming

CO-5: To study the arithmetic operations using pointers and file handling.

TEXT BOOKS:

1. E. Balagurusamy (2015), Programming in ANSI C, 6th Edition, Tata Mc-Graw Hill.

REFERENCE BOOKS:

1. Kanetkar (1999), Let us C, BPB Publication, New Delhi.
2. H. Schildt, C (2000), The Complete Reference, 4th Edition, TMH Edition
3. Ashok N. Kamthane (2006), Programming with ANSI and Turbo C, Pearson Education.

WEB RESOURCE LINKS:

1. https://www.tutorialspoint.com/cplusplus/index.html.

L	T	P	O	C
0	0	2	1	1

24PBIA22 BIOLOGICAL DATABASES AND SEQUENCE ANALYSIS-PRACTICAL III

COURSE OBJECTIVES: To understand various computational techniques employed to analyze biological data with the use of sequence information. Finally acquire skills to use different approaches for prediction of protein structure. This course also aims to provide students with a practical and hands-on experience with common bioinformatics tools and databases.

1. Retrieval of Protein Structural information using SCOP & CATH. 03
2. Protein sequence analysis - Prosite 03
3. Protein sequence analysis - Pfam 03
4. Protein sequence analysis - SOPMA 03
5. Protein sequence analysis - PROTPARAM 03
6. Multiple sequence alignment (Clustal W, Clustal Omega and DeepMSA). 03
7. Multiple sequence alignment (T-Coffee, Muscles). 03
8. Phylogenetic analysis (Rooted tree and Unrooted Tree) 03
9. Predicting Active site in 3D structure (CASTP/DeepBind) 03
10. Tool for 3D protein modelling – DeepViewer and AlphaFold. 03

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To learn how to retrieve the protein structure information from the biological databases.

CO-2: To analyze the protein sequence parameters and functions using protein sequence databases.

CO-3: To learn the sequence similarity with different sequences and their alignment.

CO-4: To discuss the active site and catalytic activity of the protein using software.

CO-5: To analyse 3D structure and their amino acids sequence using protein modelling tool.

CO-6: To explore the evolutionary relationships of proteins using phylogenetic analysis tools.

CO-7: To apply computational tools for predicting protein-protein interactions and functional annotations.

TEXT BOOKS:

1. D. Higgins and W. Taylor, (Eds) (. 2008), 'Bioinformatics: Sequences, Structures and databanks 'oxford University Press, Oxford, UK.

2. V. R. Srinivas, (2005) "Bioinformatics: Sequences and genomics analysis" cold Spring Harbor Laboratory press, Cold Spring harbor, USA.

REFERENCE BOOKS:

1. N. Gautham (2006), "Bioinformatics", Narosa Publishing Company, New Delhi.

2. D.Higgins and W. Taylor (2008), "Bioinformatics: Sequences, Structures and data banks",Oxford University Press, Oxford, UK.

WEB RESOURCE LINKS:

1. https://www.wbnsou.ac.in/library_services/ebooks.shtml#:~:text=
2. https://www.springer.com/series/7899

24DVAC21 **COMMUNICATION SKILLS**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES

- To analyze key communication concepts and barriers.
- To apply LSRW skills in effective communication.
- To demonstrate speaking and presentation skills confidently.
- To produce clear academic and professional writing.

UNIT-I INTRODUCTION TO COMMUNICATION SKILLS 06

Fundamentals of Communications, Elements of Communications, Types of Communication, Barriers to Communication and Strategies to overcome them, LSRW (Listening, Speaking, Reading & Writing), Listening Skills: Active and Passive Listening,

Activity: Listening comprehension, Listen and repeat

UNIT-II SPEAKING SKILLS 06

Types of Speeches, based on purpose and method, Fluency Development Strategies, Presentation Skills-Structure and Delivery, Group Discussion

Activity: Self-Introduction, Group Discussion

UNIT-III READING SKILLS 06

Types of Reading, Methods to Improve Reading Skills, Significance of Reading. -

Activity: Skimming, Scanning, Reading Comprehension, Critical Reading

UNIT-IV WRITING SKILLS 06

Sentence Construction. Sentence fragments- causes and strategies to fix, Transition of Sentences, How to Fix Run-on Sentences in Writing, E-Mail Writing, Social Media and Professional Presence (LinkedIn basics)

Activity: Email Writing Task (draft formal and semi-formal emails for real-life situations such as job applications, leave requests, enquiries, and complaints.)

UNIT-V VERBAL ABILITY 06

Verbal Analogy- word completion, sentence completion- Spotting Errors, Cloze Test, One word substitution, Synonyms, Idioms and Phrases, Vocabulary Building Strategies, Word Usage and Jargon.

Activity: Error Detection Exercise

Total: 30 Hours

COURSE OUTCOMES

After completing the course, students will be able to:

CO1: Explain fundamental communication concepts, types, and barriers.

CO2: Demonstrate effective listening and speaking skills in various contexts. CO3: Apply reading strategies for comprehension and critical analysis.

CO4: Construct clear and coherent sentences for academic and professional writing.

CO5: Use appropriate vocabulary and verbal ability skills accurately in communication.

REFERENCE BOOKS:

- Mohan, Krishna, and Meera Banerji. Developing Communication Skills. 2nd ed., Macmillan Education, 2018.
- Barun K. Mitra. Personality Development and Soft Skills. 2nd ed., Oxford University Press, 2016.
- Raymond Murphy. English Grammar in Use. 5th ed., Cambridge University Press, 2019.
- Norman Lewis. Word Power Made Easy. Revised ed., Goyal Publishers, 2014.
- V. Sasikumar, et al. A Course in Listening and Speaking. Cambridge University Press, 2005.

WEBSITES:

- British Council. LearnEnglish. https://learnenglish.britishcouncil.org/
- https://ebooks.inflibnet.ac.in/engp12/chapter/language-skills-lsrw-i-listening/
- https://sites.middlebury.edu/mall/resources/academics/skills/

24SSKU12 **SOFT SKILLS II**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To develop strategies to enhance teamwork and cross-functional collaboration in professional settings.
- To cultivate a positive attitude and professional resilience to foster constructive relationships and productivity.
- To develop leadership, decision-making, and strategic team-bonding skills for the workplace.

UNIT-I PROFESSIONAL BEHAVIOUR 06

- Team Building & Team Bonding: Understanding group dynamics and stages of team development.
- Inter-Personal & Intra-Personal Relationships: Emotional Intelligence (EQ) for workplace collaboration.
- Conflict Management: Basic strategies for resolving disagreements within a team setting.

UNIT-II PERSONALITY DEVELOPMENT 06

- Types of Personality: Identifying personality traits (Big Five) and their impact on job roles.
- Self-Confidence: Building professional self-efficacy and overcoming "Imposter Syndrome."
- Attitude: Shifting from a fixed mindset to a Growth Mindset; handling feedback positively.

UNIT-III TELEPHONE & VIRTUAL ETIQUETTE 06

- Basics of Telephone Etiquette: Professional greetings, active listening, and closing calls.
- Giving Clear and Concise Information: The "Elevator Pitch" model for brief updates.
- Tone, Rate of Speech, & Intonations: Managing vocal impact in remote communication.
- Digital Messaging: Professional usage of WhatsApp, Slack, and LinkedIn for business communication.

UNIT IV DECISION MAKING & LEADERSHIP 06

- Types of Decisions: Planned-Unplanned, Individual-Group, and Data-Driven Decision Making.
- Leadership Styles: Autocratic, Democratic, Laissez-faire, Participative, and Adaptive Leadership.
- Problem Solving: Basic frameworks for identifying and solving workplace issues.

UNIT V PROFESSIONAL ETIQUETTE 06

- Respect & Salutations: Gender-neutral and culturally sensitive professional address.
- Official Behaviour: Understanding Corporate Hierarchy, punctuality, and meeting protocols.
- Netiquette: Managing professional digital identity and social media presence.

Total: 30 Hours

COURSE OUTCOMES (COS):

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

- CO1: Understand the principles of team building and apply conflict resolution strategies to foster cohesion.
- CO2: Demonstrate self-confidence and a growth-oriented attitude in team management and leadership.
- CO3: Practice effective communication in telephone conversations and professional digital platforms.
- CO4: Evaluate decision-making processes and apply leadership styles appropriate to professional settings.
- CO5: Exhibit professional conduct, demeanor, and hierarchy awareness in various corporate situations.

TEXT BOOKS

- Verma, Shalini. Developing Soft Skills. 2nd ed., Pearson India, 2021.
- Mitra, Barun K. Personality Development and Soft Skills. 2nd ed., Oxford University Press, 2019.
- Alex, K. Soft Skills: Know Yourself and Know the World. S. Chand Publishing, 2020.
- Koneru, Aruna. Professional Communication. McGraw Hill Education, 2019.

REFERENCE BOOKS

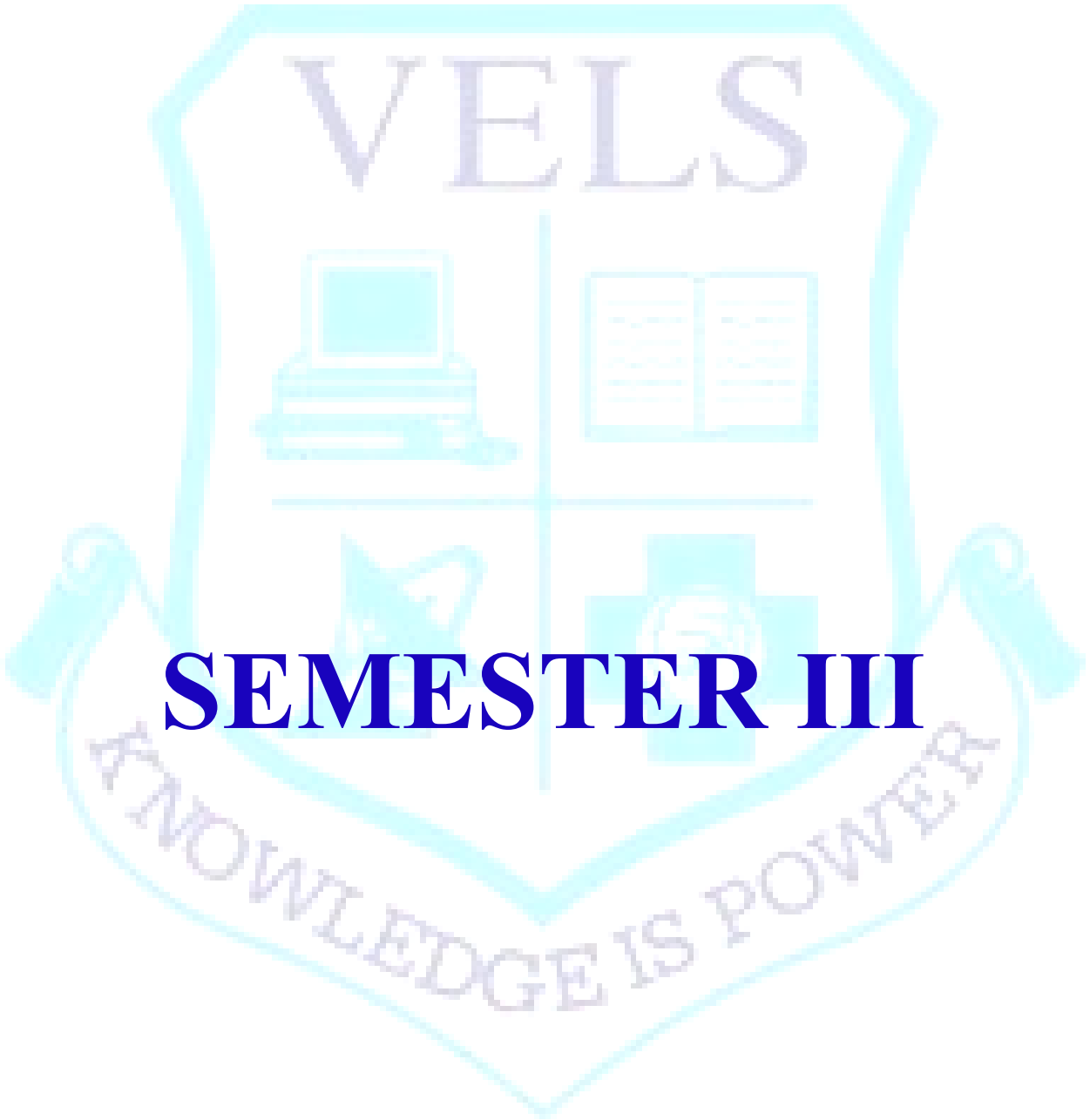
- Robbins, Stephen P., and Timothy A. Judge. Organizational Behavior. 19th ed., Pearson, 2023.
- Bradberry, Travis, and Jean Greaves. Emotional Intelligence 2.0. TalentSmart, 2019.
- Dweck, Carol S. Mindset: The New Psychology of Success. Updated ed., Ballantine Books, 2016.
- Sinek, Simon. Leaders Eat Last: Why Some Teams Pull Together and Others Don't. Penguin, 2017.
- Harvard Business Review. HBR Guide to Making Better Decisions. Harvard Business

Review Press, 2020.

- Patterson, Kerry, et al. Crucial Conversations: Tools for Talking When Stakes Are High. McGraw-Hill, 2021.
- Bovee, Courtland L., and John V. Thill. Business Communication Today. 15th ed., Pearson, 2022.

WEBSITES

- MindTools. Mind Tools Ltd., https://www.mindtools.com/.
- Harvard Business Review. Harvard University, https://hbr.org/.
- LinkedIn Learning. LinkedIn Corporation, https://www.linkedin.com/learning/.



SEMESTER III

L	T	P	O	C
2	0	0	1	2

24LTAM31 சிற்றிலக்கியம். சிறுகதை, எழுது திறன், பேச்சுக்கலை.

பருவம்-3, தமிழ்மொழிப்பாடம்-3, பகுதி-1, தகுதிப்புள்ளி: 2, வாரப் பாட நேரம்: 2. தாள்-3

பாடத்திட்ட நோக்கம்:

மாணவர்களின் இலக்கிய நாட்டத்தை மேம்படுத்துதல், பக்தி இலக்கியத்தை மாணவர்களுக்கு அறிமுகப்படுத்தி, அதன் வழி தமிழர்தம் பக்தி உணர்வையும் அதன் மேன்மையையும், கலைத்திறனையும் வெளிப்படுத்துதல், காப்பியம், புதினம் என்ற இலக்கிய வகைமைகளை அறிமுகப்படுத்துதல், மாணவர்களின் மொழித்திறனை மேம்படுத்தும் வகையில் மொழிபெயர்ப்பு, இலக்கணக் குறிப்பு என்பனவற்றை அறியச் செய்தல், மேற்கண்டவழி மாணவர்களைப் போட்டித்தேர்வுகளுக்குத் தயார் செய்தல் இந்தப் பாடத்திட்டத்தின் முக்கிய நோக்கமாகும்.

அலகு 1: சிற்றிலக்கியம் 8 மணி நேரம்

1. நந்திக்கலம்பகம் - உரைவரம் பிகந்த உயர்புகழ்ப் வானுறுமதியை அடைந்தது உன்வதனம்
2. தமிழ்விடு தூது - 10 கண்ணிகள்
3. திருக்குற்றாலக் குறவஞ்சி - மலைவளம் கூறுதல் - முதல் 5 பாடல்கள்
4. கலிங்கத்துப் பரணி - பாலை பாடியது - முதல் 5 பாடல்கள்

அலகு 2: சிறுகதை 8 மணிநேரம்

1. அறிஞர் அண்ணா - செவ்வாழை
2. புதுமைப்பித்தன் - கடவுளும் கந்தசாமிப் பிள்ளையும்
3. கி.ராஜநாராயணன் - கதவு

அலகு 3 எழுதுதிறன் 7மணி நேரம்

கலைச்சொல்லாக்கம்-தேவைகள்-கலைச்சொற்களின் பண்புகள்-
கலைச்சொல்லாக்கத்தில் தவிர்க்க வேண்டியவை - அறிவியல் கலைச்சொற்கள்.
கடிதம் -வகைகள் -அலுவலகக் கடிதங்கள்-பயிற்சி-அறிஞர்களின் கடிதங்கள்-
கடிதங்களின் வழி கற்பித்தல்-சில அறிஞர்களின் கடிதங்கள்-நேரு...,

அலகு 4: பேச்சுக் கலை **7 மணி நேரம்**

பேச்சுத்திறன் - விளக்கம் - பேச்சுத்திறனின் அடிப்படைகள் - வகைகள் -
மேடைப்பேச்சு - உடையாடல் - பயிற்சிகள்

மொத்தம்: 30 மணி நேரம்

பார்வை நூல்கள்

1. தமிழர் நாகரிகமும் பண்பாடும், டாக்டர் அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், 2001.
2. தவறின்றித் தமிழ் எழுதுவோம், மா. நன்னன், ஏகம் பதிப்பகம், 1999.
3. தவறின்றித் தமிழ் எழுத - மருதூர் அரங்கராசன், ஐந்திணைப் பதிப்பகம், 2003.
4. தமிழ் இலக்கிய வரலாறு, வரதராசன், மு., புது தில்லி: சாகித்திய அக்காதெமி, 2002.
5. புதிய தமிழ் இலக்கிய வரலாறு, நீல. பத்மநாபன், சிற்பி பாலசுப்ரமணியம், சாகித்திய அகாடெமி, 2007.
6. செம்மொழி தமிழின் சிறப்பியல்புகள் - முனைவர் மறைமலை இலக்குவனார்; https://www.youtube.com/watch?v=HHZnmJb4jSY
7. பாடநூல் தேடலுக்கான இணையம் - https://archive.org/

24LHIN31 **HINDI -III**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

1. To enrich the knowledge of students about through Thirukkural
2. To enable them to learn life values through ancient and medievial poems of Hindi Literature
3. To develop translation and advertisements skills in Hindi

UNIT I : ततरुवल्लुवव कृत ततरुक्कुव ल – 5, अमीव खुव ि◌ो कृत पहेतलया 5 'Thirukkural'-5 Kural-by Thiruvalluvar & Amir Khusro-5 Paheliyan 6hrs.

UNIT II: कबीव के दिोहे – 5

Kabir Ke Dohe,-5 6hrs.

UNIT III: तुल ◌ीदा के पद – 2 & व दा के पद – 2

Tulsidas Ke Pad-2 & SurdasKe Pad-2 6hrs.

UNIT IV: व्यावहारिक हहन्दी 1 – अनुवाद का परिचय (वअष, परिभाि◌् ◌ा व प्रकाव) & 5 - अभ्या अनुछेद

Functional Hindi 1 - Introduction to Translation (Meaning, Definition &Types) & Exercise passages – 5 6hrs

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UNIT V: व्यावहारिक हहन्दी 2 - ववज्ञापन का परिचय (वअष, परिभाि◌् ◌ा व प्रकाव) & 4 – नम ना ववज्ञापन 6hrs.

Advertisement –Introduction (Meaning, Definition & Types) & Model Advertisement - 4

Total Hours 30

COURSE OUTCOMES:

At the end of this course Students will

CO1: Know the valuable messages in social responsibilities

CO2 & CO3 Know the life values

CO4: Gain knowledge of translation in functional Hindi

CO5: Gain knowledge about advertisement skills in Hindi

TEXT BOOK:

1. Thirukkural, Bharatiya Gyanpeet, 2014.
2. Amir Khusro Ki Paheliyan, Prakrit Bharati Acadamy, 2006. Amar Prakash, Kahir Dohavali, Mahamaya Publication, 2020. Tulsidas, Dohavali, Geeta Press, Gorakhpur.
3. Vagdev, Surdas Ke Padavali, Prabhat Prakashan, 2011.

REFERENCE BOOK:

1. Rachana Vyas, Amir Khusro Ki Paheliyan, Lokoday Prakashan Pvt. Ltd., 2022.
2. Kendriya Hindi Sansthan, Banking Hindi Patyakram, 2012.
3. Kendriya Hindi Prashikshan Sansthan, Parangat, Bharat Sarkar, 2015.

WEBLINKS:

1. Thirukkural hindi translation by Venkata Krishnan Ameer khusro ki paheliyan - https://www.hktbharat.com
2. Kabir ke Dohe - Kabir granthavali , Surhranthavali-http://kavitakosh.org Tulsidas ke pad - http://kavitakosh.org

L	T	P	O	C
2	0	0	1	2

24LFRE3 **FRENCH – III**

COURSE OBJECTIVES

The lessons are being chosen:

1) to express certainty and uncertainty
2) to express one's desire to do something
3) to express one's willingness and unwillingness to do something
4) to express one's joy and sorrow
5) to express one's fear, concern and astonishment
6) to express one's anger and regrets

Units:

- Très drôle
- le passe recent, passe compose et l'imparfait 6 hours

- Vous avez dit culture l'interrogation et le subjonctif. 5 Hours
- Envie d'ailleurs
- les verbes aller/ retourner, venir/ revenir, ne...pas...ni, ne…ni…ni. 4 Hours

- Voila l'été
- le comparatif, superlatif et l'accord du participe passe avec avoir. 7 Hours

- Terre inconnue le plus-que parfait 3 Hours

- Vivement Dimanche 5 Hours
- le pronom en et y, le subjonctif et les conjugaisons irrégulières.

Total - 30 hours

COURSE OUTCOME:

- The students would be able to express certainty and uncertainty.

- The students would be able to express one's desire to do something.
- The students would be able to express one's willingness and unwillingness to do something
- The students would be able to express one's joy and sorrow.
- The students would be able to express one's fear, concern and astonishment.
- The students would be able to express one's anger and regrets.

TEXT / REFERENCE BOOK:

1. Prescribed book: LATITUDES 1 (A2/B1) MÉTHODE DE FRANÇAIS - Régine Mérieux and Yves Loiseau
2. Reference book: SAISON A2 - MÉTHODE DE FRANÇAIS - Marie-Noëlle Cocton, Élodie Heu, Catherine Houssa, Émilie Kasazian

24LENG31 ENGLISH III - ENGLISH FOR COMPETITIVE EXAMINATIONS

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES

- To develop vocabulary and verbal ability for effective communication.
- To apply grammatical structures and sentence patterns accurately.
- To analyze texts using appropriate reading strategies.
- To construct clear, coherent, and well-organized written content.
- To evaluate and refine writing for coherence, cohesion, and correctness.

UNIT I – VOCABULARY 06

- Importance of vocabulary
- Synonyms, Antonyms
- Homonyms, Homophones
- Order of words in a sentence

UNIT II - VERBAL ABILITY 06

- Idioms and Phrases
- Phrasal Verbs
- Foreign Words
- Analogy

UNIT III – READING COMPREHENSION 06

- Reading Comprehension
- Skimming, Scanning, Paraphrasing
- Identifying Main Ideas and Supporting Details
- Critical Reading, Cloze Test
- Note - making, Note – Taking
- Reading for Details

UNIT IV – WRITING 06

- Precis Writing
- Hints Developing

- Sentence Formation
- Rearranging Sentences
- Sentence Improvisation
- Sentence Completion

UNIT V – CREATIVE WRITING **06**

- Writing Story
- Sharing of experience
- Story Completion
- Reporting Conversation

COURSE OUTCOMES:

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

CO 1: identify and use appropriate vocabulary, including synonyms, antonyms, and homophones, in sentences.

CO 2: demonstrate verbal ability through correct usage of idioms, phrases, phrasal verbs, and analogies.

CO 3: analyze and interpret texts by applying reading strategies such as skimming, scanning, and identifying main ideas.

CO 4: construct well-organized written content such as précis, sentence structures, and coherent paragraphs.

CO 5: create original and imaginative pieces of writing, including stories and experiential narratives.

TEXT BOOKS

- Mohan, Krishna, and Meera Banerji. Developing Communication Skills. Macmillan India, 2010.
- Thomson, A. J., and A. V. Martinet. A Practical English Grammar. Oxford University Press, 2001.
- Das, Bikram K. Functional Grammar and Spoken and Written Communication in English. Orient Longman, 2006.

- Pillai, Sabina, and Agna Fernandez. Soft Skills and Employability Skills. Cambridge University Press, 2019.
- Sen, Leena. Communication Skills. Prentice Hall of India, 2005.
- Syamala, V. Effective English Communication for You. Emerald Publishers, 2007.
- Sasikumar, V., and P. V. Dhamija. Spoken English. Tata McGraw-Hill, 1993.
- Narayana Swami, V. R. Strengthen Your Writing. Orient Longman, 2005.

REFERENCE BOOKS:

- Norman Lewis. Word Power Made Easy. Goyal Publishers, 2019.
- Paxton, John, et al. The Least You Should Know About English: Writing Skills. Cengage Learning, 2020.
- Rizvi, M. Ashraf. Effective Technical Communication. McGraw Hill Education, 2017.
- Raman, Meenakshi, and Sangeeta Sharma. Technical Communication: Principles and Practice. Oxford University Press, 2018.
- Khanna, Meenakshi. Communication Skills in English. Khanna Publishing House, 2021.
- Kakarla, Ujjwala, et al. Functional English for Communication. Atlantic Publishers, 2022.
- Sadanand, Kamalesh, et al. English Communication for Undergraduate Students. S. Chand Publishing, 2023.
- Tyagi, Kavita, and Padma Misra. Advanced Technical Communication. PHI Learning, 2021.

WEBSITES:

- British Council: Learn English. British Council, https://learnenglish.britishcouncil.org/.
- BBC Learning English. BBC, https://www.bbc.co.uk/learningenglish/.
- Purdue Online Writing Lab (OWL). Purdue University, https://owl.purdue.edu/.
- Grammarly. Grammarly Inc., https://www.grammarly.com/.
- Vocabulary.com. Vocabulary.com, https://www.vocabulary.com/.
- Cambridge English. Cambridge University Press, https://www.cambridgeenglish.org/. Accessed 4 May 2026.
- Duolingo. Duolingo Inc., https://www.duolingo.com/

24CBIA31 **PROGRAMMING IN JAVA**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, Be aware of the important topics and principles of software development

UNIT I FUNDAMENTALS OF JAVA **9**

Basics of Object-Oriented Programming: Classes, Objects, Inheritance, Polymorphism- OOP Benefits and Applications- History and Features of Java- Java vs C/C++ and Internet Integration- Java Development Environment (JDK, JVM)- Structure of a Java Program- Data Types, Variables, Constants-Command Line Arguments and Comments.

UNIT II: CONTROL STRUCTURES AND CLASS CONCEPTS **9**

Operators: Arithmetic, Relational, Logical, Bitwise, Special- Expressions and Precedence, Type Casting-Decision Structures: if, if-else, else-if ladder, switch, ternary operator- Looping Constructs: while, do-while, for, break, continue, labeled loops- Classes and Objects: Declaration, Access, Constructors, Method Overloading- Inheritance and Method Overriding.

UNIT III: ARRAYS, STRINGS, AND PACKAGES **9**

Arrays: One and Two-Dimensional Arrays, Array Processing- Strings: String Class, StringBuffer, String Methods- Vectors, ArrayList, Wrapper Classes-Regular Expressions and String Manipulation-Interfaces and Multiple Inheritance- Java Packages: Creation, Usage, Naming Conventions, Hiding Classes.

UNIT IV: EXCEPTION HANDLING AND MULTITHREADING **9**

Errors and Exceptions: Types, Handling with try-catch-finally-Throwing and Catching Exceptions, Debugging- File Handling: Character and Byte Streams, File Attributes, Random Access Files- Data Formatting: Number and Date Formatters- Multithreading: Thread Creation, Lifecycle, Synchronization, Runnable Interface.

UNIT V: APPLETS AND GUI PROGRAMMING **9**

Applet Programming: Life Cycle, HTML Tagging, Parameter Passing- Graphics: Drawing Lines, Rectangles, Circles, Arcs, Bar Charts- AWT: Components, Layout Managers, Event Handling-Java GUI vs

Modern Technologies: JavaFX, JavaScript, HTML5, Spring Boot, WASM.

COURSE OUTCOMES:

CO1: To understands the fundamentals of Java and OOP technology.

CO2: To identify classes, objects, members of a class and relationships among them needed for a specific problem

CO3: To write Java application programs using array and String.

CO4: To demonstrate the concepts of errors, File handling using Multithreaded Programming

CO5: To write Java programs to utilizing the java applet code and graphics Programming.

CO6: To understand the security risks and the evolution of web technologies.

CO7: To cross validate the alternatives to Java Applets and Modern Browsers.

TEXT BOOKS:

1. E. Balagurusamy, 2010, "Programming with Java: A Primer", Fourth Edition, Tata McGrawHill,.

REFERENCE BOOKS:

1. P. Naughton and H. Schildt, 2015, Java2 , (The Complete Reference) Third Edn.TMH.

2. Deital & Deital, "How to Program Java", Pearson Education, 1999. Cays Horstmann, Gary Cornell, "Core Java 2: Advanced Features", Sun Micro System,20.

WEB RESOURCE LINKS:

1. https://www.gutenberg.org/

L	T	P	O	C
3	0	0	2	3

24CBIA32 RECOMBINANT DNA TECHNOLOGY

COURSE OBJECTIVES: The objective of this course on Recombinant DNA Technology is to provide students with a comprehensive understanding of the principles and methodologies involved in genetic manipulation. Students will gain hands-on experience with techniques such as gene cloning, PCR, and gene editing tools like CRISPR-Cas9.

UNIT I MOLECULAR CLONING- TOOLS 9

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

UNIT II INTRODUCTION OF DNA INTO LIVING CELLS AND SCREENING TECHNIQUE 9

Transformation-Competent cell preparation-Selection of Transformed cells- Transformation methods - Calcium phosphate co-precipitation method, Electroporation, Microinjection, biolistic method, virus and liposome mediated delivery, Screening of Recombinants- Colony selection, Antibiotic resistance. Construction of Genomic and CDNA libraries- Chromosome Jumping and Walking.

UNIT III DNA AMPLIFICATION AND DNA SEQUENCING 9

Polymerase Chain Reaction- principle and Application- Primer Designing, RT-PCR, DNA Sequencing- Sangers method, Maxam and Gilbert method.

UNIT IV TECHNIQUES IN RDNA TECHNOLOGY 9

Blotting technique- Probe preparation- Southern blotting, Northern Blotting, Western Blotting- Agarose gel electrophoresis, SDS- PAGE, DNA Polymorphism- RFLP, RAPD, AFLP.

UNIT V APPLICATIONS OF RDNA TECHNOLOGY 9

Genetically Engineered hGH, Recombinant Human Insulin, Delayed fruit Ripening using Antisense RNA Technology, Recombinant vaccine, genetically modified plant -BT Cotton, Brinjal, Gene therapy

Total: 45 Hours

COURSE OUTCOMES:

- CO-1: To understand the fundamental principles of recombinant DNA technology.
- CO-2: To design and conduct experiments involving the manipulation of DNA.
- CO-3: To develop proficiency in analyzing and interpreting data from recombinant DNA.
- CO-4: To study recombinant DNA technology.
- CO-5: To equipped to apply recombinant DNA techniques in various fields.
- CO-6: To Assess the applications of recombinant DNA technology in medicine, agriculture, and biotechnology.
- CO7**:** To Design strategies for genetic modifications, including recombinant vaccines, gene therapy, and genetically modified plants.

TEXT BOOKS:

1. Michael R. Green and Joseph Sambrook, 2012, Molecular Cloning: A Laboratory Manual, 4th Edition,

REFERENCE BOOKS:

1. Sandy B. Primrose, Richard Twyman, 2006, Principles of Gene Manipulation and Genomics, 7th Edition,
2. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan A. Witkowski, 2017, Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edition.
3. Bernard R. Glick and Cheryl L. Patten 2024, *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, 5th Edition, ASM Press, Washington, DC, USA.

WEB RESOURCE LINKS:

1. https://archive.org/details/recombinantdnate0000unse_b6a8
2. https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_(Suza_and_Lee)/01%3A_Chapters/1.11%3A_Recombinant_DNA_Technology.

24MBIA31 ENZYMES AND METABOLISM

L	T	P	O	C
3	0	0	2	3

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

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes – six major classes of enzymes with one example each. Elementary study of the factors affecting velocity of enzyme catalyzed reactions Michaelis-Menten equation. Km and its significance, Cofactors and coenzymes, Group specificity, Optical specificity, Geometrical specificity, Cofactor specificity of enzyme with example.

UNIT II INTRODUCTION TO METABOLISM 9

Introduction to metabolism- Types of Metabolism, process of Metabolism, Catabolism, anabolism, catabolic, anabolic and amphibolic pathways, Nutrition and Energy, Overview of Carbohydrates, Proteins, Lipids in Metabolism

UNIT III CARBOHYDRATE METABOLISM 9

Glycolysis, Fates of pyruvate – lactic acid fermentation, Fates of pyruvate – alcohol fermentation, Pyruvate dehydrogenase reaction, Citric acid cycle, Substrate level phosphorylation, Electron transport chain, Oxidative phosphorylation, Glycogen metabolism – glycogenesis, glycogenolysis.

UNIT IV LIPID METABOLISM 9

Fatty acid biosynthesis, Oxidation of fatty acids – Fatty acid activation, Carnitine shuttle. β- Oxidation of fatty acids, explain using palmitic acid and ATP yield, Ketone bodies, Cholesterol biosynthesis

UNIT V PROTEIN METABOLISM 9

Decarboxylation of amino acids, Deamination of amino acids, Transamination of amino acids, Urea Cycle, Glucogenic amino acids with examples, Ketogenic amino acids with examples.Overview of amino acid metabolism, Catabolism of amino acids, Biosynthesis of amino acids, Precursor functions of amino acids. Digestion and absorption of dietary proteins. Protein calorie malnutrition, Nitrogen balance, transamination, urea cycle and inherited defects of urea cycle.

Total: 45 Hours

COURSE OUTCOMES:

- CO-1: To understand the fundamentals of enzymes, cofactors and coenzymes actions.
- CO-2: To acquire the concepts of metabolism and metabolic pathways of macromolecules.
- CO-3: To study the carbohydrate metabolism by both aerobic and anaerobic respiration.
- CO-4: To acquire the knowledge of oxidation of fatty acids.
- CO-5: To study the protein metabolism using cycles.
- CO-6: To intersect complex biochemical process involving the digestion, absorption, synthesis, and breakdown of proteins.
- CO-7: Advanced topics in protein metabolism that are of interest in biochemical and medical research

TEXT BOOKS:

1. Lehninger, A. L. 2021, Principles of Biochemistry. CBS publishers and distributors, New Delhi, India, 8th edition.

REFERENCE BOOKS:

1. C. K. Mathews, K. E. Van Holde, & K.G. Ahern, 2018, “Biochemistry”, Third Edition, Prentice Hall.
2. Shanmughavel P, 2015, “Principles of Bioinformatics”, Pointer Publishers, Jaipur, India.

WEB RESOURCE LINKS:

1. https://link.springer.com/book/10.1007/978-981-13-0785

L	T	P	O	C
3	0	0	2	3

24DBIA31 MEDICAL CODING AND TRANSCRIPTION

COURSE OBJECTIVES: The Human Anatomy course involves the study of the structure of the human body. To provide a sound knowledge of medical coding guidelines and regulations including compliance and reimbursement and to make the student to learn about ICD-10 (Diagnosis code), CPT code and medical terminologies.

UNIT I INTRODUCTION TO HUMAN ANATOMY – I **09**

Basics of Human Anatomy and Physiology, Cell, Tissues and Membrane, The integumentary system, Skeletal system, Muscular system, Endrocrine system, Nervous system.

UNIT II INTRODUCTION TO HUMAN ANATOMY - II **09**

Cardiovascular system, Respiratory system, Digestive system, Urinary system and Reproductive system. Coding medical procedures What to code and how to prepare the forms.

UNIT III CLAIM INFORMATION AND MEDICAL RECORDS **09**

Professional claim information How to set up medical claims for Medicare, Medicaid, private insurance companies, HMOs, PPOs, workers' compensation and personal injury cases. Documenting Medical Records: The role medical records play in a coding specialist's job. The importance of documentation in medical records and to recognize the various types of dictation formats and manage medical records. Medical Ethics Concepts of ethics, compliance, fraud and abuse. The importance of confidentiality when dealing with medical records and insurance audits and the legal concepts involved.

UNIT IV CPT CODES **09**

CPT Coding: CPT Coding from the Integumentary System, from the Reproductive Systems to the Operating Microscope, for Radiology, Pathology, Medicine and Anesthesia, Evaluation and Management Services, Comprehensive CPT Evaluation and Management, Surgery Coding, Digestive System Coding, Urology system coding, Cardiovascular coding.

UNIT V DIAGNOSTIC CODES **09**

Diagnostic Coding - ICD-10-CM Coding Manual Introduction, Diagnosis Coding: Guidelines and Rules,

from Infections to Blood Diseases, from Mental Disorders to the Respiratory System from the Digestive System to Pregnancy, from the Skin to Conditions of the Perinatal Period, from Symptoms to Complications, V, X, Y Codes, and ICD-10-CM Coding Practicum.

Total: 45 Hours

COURSE OUTCOMES:

- CO-1: Build a fundamental understanding of the human body and medical terminology as they apply to medical billing and coding.
- CO-2: To acquire the concepts of human anatomy and physiology of different systems of the body.
- CO-3: Demonstrate professionalism through acceptable attitude, organization and time management skills, and attire.
- CO-4: Assign the diagnostic and procedure codes using CPT coding systems as used in a variety of settings.
- CO-5: Understand diagnostic and procedure codes using ICD coding principles and skills in the workplace.
- CO-6: Demonstrates in-depth understanding of ICD-10-CM coding manual structure, coding rules, system-wise diagnostic categorization, and real-time application through coding practicum.
- CO-7: To Possesses a clear understanding of disease coding pathways, chapter-specific coding logic, and application of official coding guidelines in real-world healthcare settings.

TEXT BOOKS:

1. Beth A. Rich, 2013. “Medical Coding: A Journey”, Prentice Hall, ISBN – 13: 9780132541770
2. Martini and Nath. 2018, Fundamentals of Anatomy and Physiology Modified Mastering A&P Access Code. Pearson, San Francisco, CA. 11th ed.+ ,.

REFERENCE BOOKS:

1. Karen Smiley, 2012, “Medical Coding and Billing for Dummies”, Second Edition,.
2. Perez. Anatomy (Flash Cards), 2008, Bar Charts Publishing, Boca Raton, FL,.
3. Kapit and Elson, 2013, Anatomy Coloring Book 12th ed. Pearson Education, Boston, MA,.

WEB RESOURCE LINKS:

- https://www.aapc.com/resources

24DBIA3_ **MEDICINAL CHEMISTRY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: To study introduction to medicinal chemistry, computational modeling, combinatorial chemistry, anti-infective agents and analogs studies.

UNIT I INTRODUCTION 09

Introduction to Medicinal Chemistry-Folk and Herbal Medicine -Introduction to Important Functional Groups in Medicinal Chemistry-Physico-chemical Aspects and Principals of Drug Action-Functional Groups and Isosteres (peptidomimetics)

UNIT II COMPUTATIONAL MODELING 09

Introduction to Computational Molecular Modeling- Quantitative Structure Activity Relationships (QSAR) Metabolism and Prodrugs - Drug-Receptors Interactions and Receptor-Effector Theories-Enzymes: catalysis, representative mechanisms of action and inhibition/inactivation-Receptors and transporters -DNA-interactive drugs. Drug-Target Interaction Prediction: DeepChem.

UNIT III COMBINATORIAL CHEMISTRY 09

Combinatorial Chemistry and Rapid Parallel Syntheses - General properties, chemistry, biological action, structure activity relationship and therapeutic applications of Alicyclic compounds- Alkaloids-Vitamins-Hormones

UNIT IV ANTI-INFECTIVE AGENTS 09

Anti-Infective Agents: Anti-viral Agents-Anti-bacterial Agents-Neuroactive Agents: CNS Depressants-CNS Stimulants-Cholinergic Agents-Adrenergic, Dopaminergic and Serotenergic Agents

UNIT V ANALOGS STUDIES 09

Neuroactive Amino Acid Analogs: GABA, Glutamate and Glycine -Cardiovascular Agents (Renin-Angiotensin, etc.)-Antineoplastic Agents (mustards, anti-folates, etc.) -Steroids, Hormones and Cholesterol Lowering Agents.

Total: 45 Hours

COURSE OUTCOMES:

- CO-1: Understand the details about Quantitative Structure Activity Relationships.
- CO-2: Identify the applications of Combinatorial Chemistry
- CO-3: Apply the therapeutic applications of Alicyclic compounds.
- CO-4: Know the details about Neuroactive Agents.
- CO-5: Describe the steps involved in Drug Discovery.
- CO-6: Investigate neuroactive amino acid analogs, such as GABA, glutamate, and glycine.
- CO-7: Analyze cardiovascular agents, including those targeting the renin-angiotensin system.

TEXT BOOKS:

1. Foye's Principles of Medicinal Chemistry, 2022, 5th edition; David A. Williams, William O. Foye, Thomas L. Lemke; Lippincott Williams & Wilkins: Philadelphia.
2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 2015,11th edition; Delgado & Remers, Eds.; Lippincott Williams & Wilkins: Philadelphia.

REFERENCE BOOKS:

1. Delgado, J and Remers, W., 2016, "Textbook of Organic Medicinal and Pharmaceutical Chemistry," Lippincott-Raven, Philadelphia,
2. Perum J. and Propst C.L. Computer-Aided Drug Design Methods and Applications, 2018, Marcel Dekker Inc., New York,
3. Richard B. Silver, 2014, The Organic Chemistry of Drug Design and Drug Action. Academic Press, Pnen, Inc., USA.

WEB RESOURCE LINKS:

1. https://benthamscience.com/journals/medicinal-chemistry/
2. https://pubs.acs.org/journal/jmcmar
3. https://www.journals.elsevier.com/bioorganic-and-medicinal-chemist

L	T	P	O	C
0	0	2	1	1

24PBIA31 PROGRAMMING IN JAVA PRACTICAL IV

COURSE OBJECTIVES: Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.

1.	Operators and Expressions	**02**
2.	Branching and Looping	**02**
3.	Classes and Objects	**02**
4.	Packages	**02**
5.	Formatting Data	**02**
6.	Sort an Array of Strings in Reverse Order	**02**
7.	Implementing Case Differences Ignorance	**03**
8.	Applet Example	**03**
9.	Drawing Circle, rectangle using Java Graphics.	**03**
10.	Write a Java program that can manipulate biological sequences (DNA, RNA, or protein)	**03**
11.	Write a program to compute the reverse complement of a DNA sequence	**03**
12.	Use **BioJava** to handle biological data analysis and sequence manipulation	**03**

Total:30 Hours

COURSE OUTCOMES:

- CO-1: To understands the fundamentals of Java and OOP technology.
- CO-2: To identify classes, objects, members of a class and relationships among them needed for a specific problem
- CO-3: To write Java application programs using array and String.

- CO-4: To demonstrate the concepts of errors, File handling using Multithreaded Programming
- CO-5: To write Java programs to utilizing the java applet code and graphics Programming.
- CO-6: Implement methods to read and write FASTA files using BioJava for sequence analysis.
- CO-7: Apply sequence similarity measures to identify conserved regions and mutations.

TEXT BOOKS:

1. E. Balagurusamy, 2021, “Programming with Java: A Primer”, 8th Edition, Tata McGrawHill,

REFERENCE BOOKS:

1. P. Naughton and H. Schildt,2015, Java2 (The Complete Reference) - Third Edn. TMH.
2. Deital & Deital, 1999 , “How to Program Java”, Pearson Education.
3. Cays Horstmann, Gary Cornell, 2007, “Core Java 2: Advanced Features”, Sun Micro System.

WEB RESOURCE LINKS:

1. https://docs.oracle.com/javase/tutorial/
2. https://www.coursera.org/specializations/java-programming

24PBIA32 RECOMBINANT DNA TECHNOLOGY PRACTICAL IV

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES: The objective of this course on Recombinant DNA Technology is to provide students with a comprehensive understanding of the principles and methodologies involved in genetic manipulation. Students will gain hands-on experience with techniques such as gene cloning, PCR.

1.	Sterilization Technique	**03**
2.	Isolation of Genomic DNA from E. coli.	**05**
3.	Isolation of Plasmid DNA- Kit Method	**05**
4.	Restriction digestion of DNA and Agarose Gel Electrophoresis	**05**
5.	DNA ligation	**03**
6.	Demonstration about Competent Cell preparation and Transformation	**03**
7.	Screening of Recombinants- Blue, White Selection	**03**
8.	Demonstration of Southern Blotting	**03**

Total: 30 Hours

COURSE OUTCOMES:

- CO-1: To Mastery of Laboratory Techniques
- CO-2: To acquire the ability to perform and interpret the results.
- CO-3: To equipped to apply recombinant DNA techniques in various.
- CO-4: To Demonstrates comprehensive understanding and practical proficiency in essential gene cloning and detection techniques, including transformation efficiency analysis and hybridization-based DNA detection.
-
- CO-5: To Possesses practical insight into molecular cloning workflows, selective screening of

transformed cells, and DNA analysis using probe-based detection methods

TEXT BOOKS:

- Michael R. Green and Joseph Sambrook, 2012, Molecular Cloning: A Laboratory Manual, 4th Edition,

REFERENCE BOOKS:

- Sandy B. Primrose, Richard Twyman, 2006, Principles of Gene Manipulation and Genomics, 7th Edition.
- Bernard R. Glick and Cheryl L. Patten (2024), *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, 5th Edition, ASM Press, Washington, DC, USA.

WEB RESOURCE LINKS:

- https://www.ncbi.nlm.nih.gov/books/NBK21737/
- https://www.khanacademy.org/science/ap-biology/gene-expression-and- regulation/biotechnology

24EMDE31 **INDIAN KNOWLEDGE SYSTEM**

L	T	P	O	C
1	1	0	1	2

COURSE OBJECTIVES:

To Gain an understanding of Indian Knowledge System. To Develop an ability to apply the Indian Knowledge System to societal challenges faced today in areas such as holistic health, governance, public administration and sustainable living. To Promote the youths to do research in the various fields of Indian knowledge system.

UNIT I AN OVERVIEW OF INDIAN KNOWLEDGE SYSTEM 06

Introduction- Organization of Indian Knowledge System- The IKS corpus- A Classification framework- Historicity of Indian Knowledge System -Some salient aspects of Indian Knowledge System.

UNIT II PHILOSOPHICAL SYSTEM 06

Introduction to Philosophy- Development of Indian Philosophical system - Unique features of Indian Philosophical system- Introduction to Yoga.

UNIT III GOVERNANCE AND PUBLIC ADMINISTRATION 06

Introduction - Understanding Governance from ancient to modern times- Relevance of Arthashastra- Glimpses of Nitishastra- Vidura Niti.

UNIT IV WISDOM THROUGH THE AGES 06

Gateways of ancestral wisdoms-Introduction to Purana- The Puranic repository- Issues of interest in Puranas- Introduction to Itihasas- Key messages in Itihasas-Wisdom through Nitishastra.

UNIT V MATHEMATICS 06

Introduction to Indian Mathematics- Unique aspects of Indian Mathematics- Indian Mathematicians and their Contributions.

Total hours: 30 hours

COURSE OUTCOMES

- CO1: Classify the key concepts of Indian Knowledge System and discuss the multi-faceted nature of knowledge contained in the Traditional Systems of India.
- CO2: Identify the rich heritage of governance in Indian Knowledge System.
- CO3: Recognize the relevance of Arthashastra in public administration.
- CO4: Identify the Wisdom through Ages through Ithihasas.
- CO5: Knowledge of Indian Mathematicians and their contributions.

TEXT BOOKS:

- Mahadevan B., Bhat V R, Nagendra Pavana R.N., 2022, Indian Knowledge System Concepts and Application, PHI Learning Pvt. Ltd.
- Kapoor Kapil, and Singh Avadesh Kumar, Indian Knowledge System, 2005, Vol.1, DK Print World, Ltd.

REFERENCE BOOKS:

- Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan.
- History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata

WEB RESOURCE LINKS:

- https://onlinecourses.swayam2.ac.in/imb23_mg54/preview
- https://digest.iimb.ac.in/2022/04/book-indian-knowledge-systems-co-authored-dr-b- mahadevan/
- https://www.summarize.tech/www.youtube.com/watch?v=jcV0LIp570A

24SSKU13 **SOFT SKILLS –III**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To enhance students' listening, speaking, and professional presentation skills for high-impact communication.
- To develop agile leadership, decision-making, and problem-solving abilities tailored for corporate environments.
- To master the art of non-verbal cues and professional branding to ensure recruitment success.

UNIT-I: LISTENING SKILLS & PROFESSIONAL FEEDBACK 06

- Basics of LSRW Skills: Integrating Listening, Speaking, Reading, and Writing for corporate literacy.
- Active Listening: Mastering empathy and focused attention in professional meetings.
- Feedback Loops: Giving and receiving constructive feedback using the "Sandwich Method."
- Listening for Comprehension: Extracting key action points from complex verbal instructions.

UNIT-II: SPEAKING & PRESENTATION STRATEGIES 06

- Public Speaking: Essential elements of a successful speech and impromptu speaking (Extempore).
- Voice Modulation: Effective use of tone, pitch, and "Power Pauses" for authority.
- Presentation Skills: Creating high-impact slides; mastering Virtual Presentations (Camera eye-contact and screen-sharing etiquette).

UNIT-III: LEADERSHIP & STRATEGIC EXECUTION 06

- Basics of Leadership: Identifying Traits, Styles, and Situational Leadership.
- Decision-Making & Problem-Solving: Using frameworks like the "5 Whys" for root-cause analysis.
- Delegation & Accountability: Learning how to assign tasks and take ownership of results in a team.

- UNIT-IV: NON-VERBAL CUES & INTERVIEW ETIQUETTE 06
  - Body Language & Kinesics: Facial expressions, gestures, posture, and eye contact in Interview

settings.

- Professional Grooming: Appearance and dress codes for different industries (Formal vs. Startup Casual).
- The STAR Technique: Using Situation, Task, Action, and Result to communicate non-verbal confidence during high-pressure interviews.

UNIT-V: WORKPLACE ETHICS & PROFESSIONALISM **06**

- Workplace Etiquette: Professional behaviour in hybrid offices; email and Slack/Teams etiquette.
- Integrity & Responsibility: Understanding professional boundaries and accountability.
- Ethical Decision-Making: Navigating workplace dilemmas and maintaining long-term professional credibility.

Total: 30 Hours

COURSE OUTCOMES:

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

- CO1: Acquire the ability to actively listen and provide professional feedback that improves team productivity.
- CO2: Deliver effective speeches and digital presentations using modulation and visual aid techniques.
- CO3: Apply leadership traits and strategic delegation to solve complex workplace problems.
- CO4: Master non-verbal cues and the STAR technique to excel in professional interviews and social networking.
- CO5: Uphold high standards of professional ethics and integrity in diverse workplace environments.

TEXT BOOKS

- Bovee, Courtland L., and John V. Thill. Business Communication Today. 15th ed., Pearson, 2022.
- Harvard Business Review. HBR Guide to Persuasive Presentations. Harvard Business Review

Press, 2019.

REFERENCE BOOKS

- Patterson, Kerry, et al. Crucial Conversations: Tools for Talking When Stakes Are High. McGraw-Hill, 2021.
- Gallo, Carmine. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds. St. Martin's Press, 2014.
- Pease, Allan, and Barbara Pease. The Definitive Book of Body Language. Bantam, 2017.
- Johnson, Craig E. Ethics in the Workplace: Tools and Tactics for Organizational Transformation. SAGE, 2021.

WEB RESOURCES:

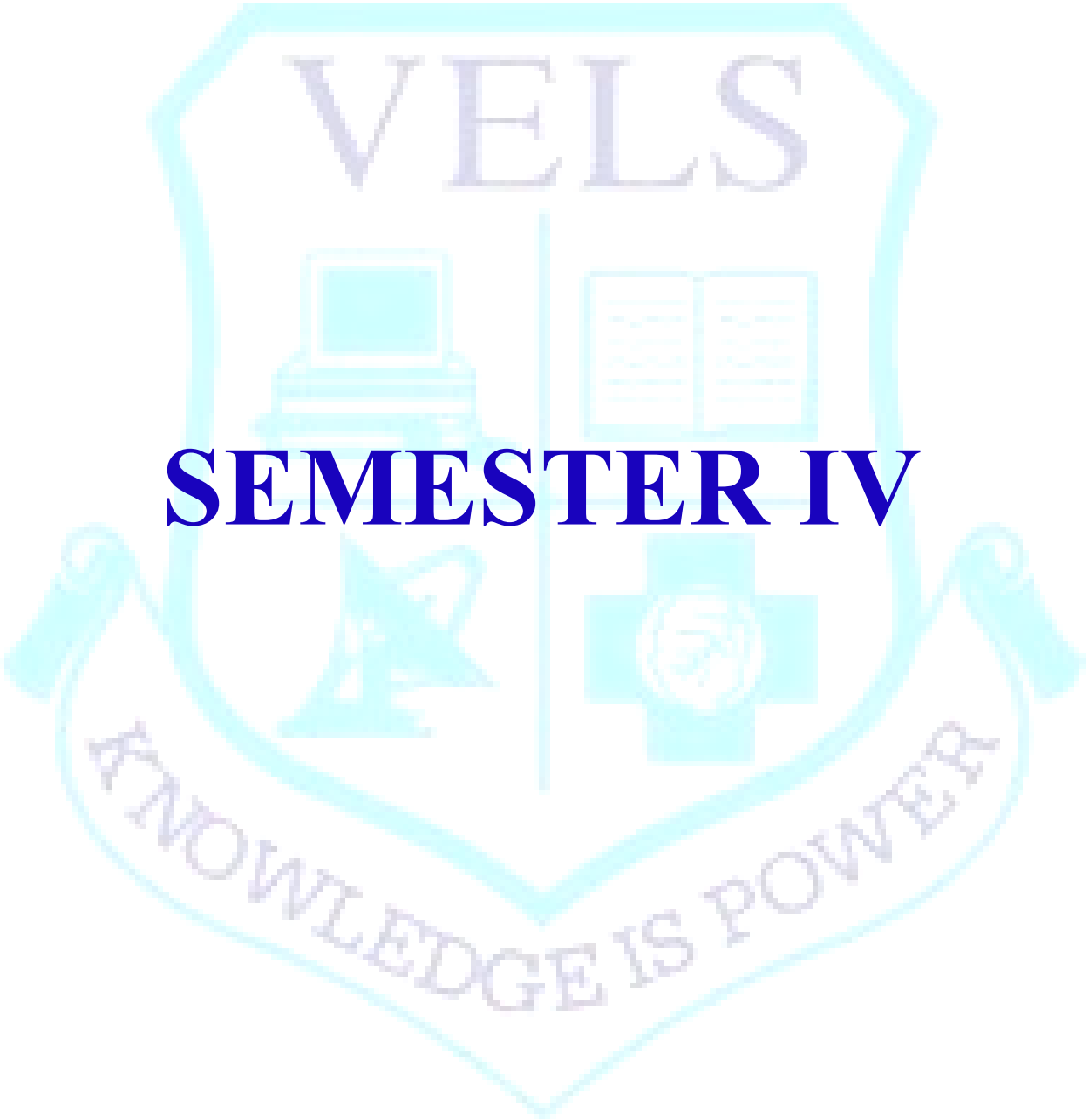
- https://www.ted.com/
- https://www.indeed.com/career-advice

24IBIA31 **INTERNSHIP I**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES:

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



SEMESTER IV

L	T	P	O	C
2	0	0	1	2

24LTAM41 மரபுக்கவிதை, புதுக்கவிதை, ஊடகத்தமிழ், கணினித்தமிழ்.

பருவம்-4, தமிழ்மொழிப்பாடம்-4, பகுதி-1, தகுதிப்புள்ளி: 2, வாரப் பாட நேரம்: 2.

தாள்-4

பாடத்திட்ட நோக்கம்:

தமிழர்தம் தொன்மைச் சிறப்பையும், பண்பாட்டுச் செழுமையையும் உலகிற்குப் பறைசாற்றும் சங்க இலக்கியங்களான எட்டுத்தொகை, பத்துப்பாட்டு நூல்களை அறியச் செய்தல், அதன்வழி பண்டைத் தமிழரின் விழுமியங்களை எடுத்துரைத்தல், இலக்கால இலக்கிய வகைமையான நாடக இலக்கியத்தை அறியச் செய்தல், ஊடகங்களில் தமிழின் பயன்பாடு, கணினியில் தமிழ்ப்பயன்பாடு என்பனவற்றை மாணவர்களுக்கு கற்றுக்கொடுத்தல், மாணவர்களை ஆளுமை மிக்கவர்களாக உருவாக்கி, போட்டித் தேர்வுகளுக்குத் தயார் செய்தல் என்பன இந்தப் பாடத்திட்டத்தின் முக்கிய நோக்கமாகும்.

அலகு 1: மரபுக்கவிதை — 8 மணி நேரம்

1. பாரதியார் - பாரத தேசம் என்னும் தலைப்பில் ஆறு பாடல்கள்.

(பாடல் எண்கள் 1, 6, 7, 9, 12, 13)

2. பாரதிதாசன் – தமிழுக்கும் அமுதென்று பேர் என்னும் தலைப்பிலான கவிதை.

3. தேசிக விநாயகம் பிள்ளை - உடல் நலம் பேணல் என்னும் தலைப்பிலான கவிதை

4. முடியரசன் - காவியப் பாவை – "புண்படுமா" என்னும் கவிதை.

அலகு 2: புதுக்கவிதை — 8 மணிநேரம்

1. நா. காமராசன் - கறுப்பு மலர்கள் தொகுப்பில் காகிதப்பூக்கள் என்னும் தலைப்பிலான கவிதை.
2. அப்துல் ரகுமான் - ஆலாபனை தொகுப்பில் போட்டி என்னும் தலைப்பிலான கவிதை
3. ஆண்டாள் பிரியதர்ஷினி - முத்தங்கள் தீர்ந்துவிட்டன தொகுப்பில் 'இங்கே வரும் போது' என்னும் தலைப்பிலான கவிதை

அலகு 3 ஊடகத் தமிழ் **7மணி நேரம்**

இதழியல் - ஊடக வகைகள் - தலையங்கம்- நிகழ்ச்சியை செய்தியாக மாற்றுதல்- கருத்துப் பரிமாற்றம் நாடகம், திரைப்படம்,- வானொலி- தொலைக்காட்சி- மொழி நடையின் தன்மை

அலகு 4: கணினித் தமிழ் **7 மணி நேரம்**

கணினித் தமிழ்: கணினித் தமிழின் அடிப்படையும் பயன்பாடும் - கணிப்பொறியின் வரலாறும் வளர்ச்சியும், கணினியும் தமிழும், விசைப்பலகை (Keyboard)- எழுத்துருக்கள் (Fonts) - தமிழைத் தட்டச்சு செய்ய உதவும் மென்பொருள்கள், தமிழைத் தட்டச்சு செய்யும் முறைகள் - தமிழ்த் தட்டச்சுப் பயிற்சி - இணையமும் தமிழ்ப் பயன்பாடும் - தேடுபொறி (Search) - வலைப்பூ (Blog), மின்னூலகம் (Online e-Library), - மின்னகராதி(e-Dictionary), - மின் செய்தித்தாள் - e-Paper, - இணையவழித் தமிழ்க் கற்றலும்-கற்பித்தலும் - மின்வழிக் கற்றல் - e Learning.

மொத்தம்: 30 மணி நேரம்

பார்வை நூல்கள்

1. தமிழர் நாகரிகமும் பண்பாடும், டாக்டர் அ. தட்சிணாமூர்த்தி,

ஐந்திணைப் பதிப்பகம், 2001.

2. தவறின்றித் தமிழ் எழுதுவோம், மா. நன்னன், ஏகம் பதிப்பகம், 1999.
3. தவறின்றித் தமிழ் எழுத - மருதூர் அரங்கராசன், ஐந்திணைப் பதிப்பகம், 2003.
4. தமிழ் இலக்கிய வரலாறு, வரதராசன், மு., புது தில்லி: சாகித்திய அக்காதெமி, 2002.
5. புதிய தமிழ் இலக்கிய வரலாறு, நீல. பத்மநாபன், சிற்பி பாலசுப்ரமணியம், சாகித்திய அகாடெமி, 2007.
6. செம்மொழி தமிழின் சிறப்பியல்புகள் - முனைவர் மறைமலை இலக்குவனார்; https://www.youtube.com/watch?v=HHZnmJb4jSY
7. பாடநூல் தேடலுக்கான இணையம் - https://archive.org/

24LHIN41 HINDI -IV (MODERN POETRY, OFFICIAL (LANGUAGE & STAGE MANAGEMENT)

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To develop interest in various style of Modern and Contemporary Hindi Poetry
- To enable them to know about the Official Language Hindi
- To enable them to converse in Hindi

UNIT I : भाव तेन्दु हरिश्चंद्र की मुखरिया – 4
Bharatendu Harishchandra ki Mukhariyan-4. 6hrs.

UNIT II : ुतमत्रानंदन पंत कृत 'भाव तमाता ग्रामवा ी' (कववता)
'Bharatmata Gramavasi' (Kavita) by Sumitranand Pant 6hrs.

UNIT III: ज्ञानेन्द्रपतत कृत 'बीज व्व्या' (कववता)
'Beej Vyatha' (Kavita) by Gyanendrapati 6hrs.

UNIT IV: व ाजभाि् ा हहन्दी का परिचय, अनुछेद े प्रश्न तनमाषण
Introduction to Official Language Hindi, framing questions from passages 6hrs.

UNIT V : मंच ंचालन (ाक्षात्काव) का परिचय
Introduction to Stage Management(Interview) 6hrs.

Total: 30 hours

COURSE OUTCOME:

At the end of this course Students will be able to

CO-1 Familiar with the different poetic expressions of Modern & Contemporary Hindi Poetry

CO-2 Familiar with the different poetic expressions of Modern &Contemporary Hindi Poetry

CO-3 Familiar with the different poetic expressions of Modern &Contemporary Hindi Poetry

CO- 4 Know the importance of official language Hindi

CO-5 Become conversant in Hindi

TEXTBOOK:

- Bhartendu Harishchandra, Ed.Ramji Yadav,
- Bharatendu Sanchayan, Bharatiya Pustak Parishad, 2011.
- Sumitranandan Pant, Gramya, Lokbharti Prakashan, 2017.
- Gyanedrapati, Gyanendrapati, Prabhakar Publication, 2022.

  Bhatia Kailashchandra, Rajbhasha Hindi, Vani Prakashan,2018.

REFERENCE BOOK:

- Mahesh Sharma, Bhashan Kala, Prabhat Prakashan, 2019.
- Raghavan T.E.S. Rajbhasha Hindi Amarkosh.

WEBLINKS:

- -http://kavitakosh.org Bharatendu
- Harishchandra
- https://www.amarujala.com/kavya/kavya-charcha/bhartendu-harishchandra-poems- naye- jamane-ki-mukariyan?page=5
- Sumitranandan Pant- http://kavitakosh.org
  https://www.hindiadda.com/beej-vyatha-gyanendrapati/ Hindi Rajbhasha:
  https://navodaya.gov.in

24LFRE41 **FRENCH IV**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

The lessons are being chosen:

1) to propose to do something and respond to a proposal
2) to respond to a request
3) to accuse, to blame
4) to complain, to protest
5) to express cause and consequence
6) to express opinion about facts

UNITS:

1) Entreprendre

Les pronoms démonstratifs, les pronoms interrogatifs. 6 hours

2) Vous avez gagne

Les pronoms en et y, les formation des adverbes en-ment 5 hours

3) Ne quittez pas

La mise en relief (c'est ..... qui, c'est …….que). 4 hours

4) Argent trop cher

l'opposition- toujours/ne…jamais. 4 hours

5) Le pétrole fou

la cause et la consequence. 5 hours

6) Parlez-moi d'amour

le conditionnel present, le gérondif. 6 hours

Total: 30 hours

COURSE OUTCOMES

1. The students would be able to propose to do something and respond to a proposal
2. The students would be able to respond to a request
3. The students would be able to accuse, to blame
4. The students would be able to complain, to protest
5. The students would be able to express cause and consequence
6. The students would be able to express opinion about facts

TEXT / REFERENCE BOOK:

1. Prescribed book: LATITUDES 1 (A2/B1) MÉTHODE DE FRANÇAIS - Régine Mérieux and Yves Loiseau
2. Reference book: SAISON A2 - MÉTHODE DE FRANÇAIS - Marie-Noëlle Cocton, Élodie Heu, Catherine Houssa, Émilie Kasazian

24LENG41 ENGLISH IV PROFESSIONAL ENGLISH

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

- To improve professional vocabulary and language usage appropriate for various fields and industries.
- To practice critical thinking and problem-solving skills through case studies and discussions.
- To prepare students for job interviews and career advancement through professional English proficiency.

UNIT- I REPORT WRITING AND DATA INTERPRETATION 06

- Report Writing -Business Report, Progress Report, Technical Report
- Instructions and Recommendations
- Interpretation of Graphs, Charts and Pictures

UNIT II PROFESSIONAL WRITING I 06

- Agenda
- Minutes of the Meeting
- Review Writing
- Circular

UNIT-III PROFESSIONAL WRITING II 06

- Paragraph Writing
- Essay Writing
- Proposal Writing
- E-mail Writing

UNIT IV SPEECH WRITING 06

- Tailoring the Speech for the Target Audience
- Writing for Professional Events - Welcome Address, Vote of Thanks
- Maintaining Clarity, Conciseness, and Precision

UNIT V MEDIA WRITING **06**

- Introduction to Media Writing - News, Feature, Editorial, and PR
- Writing for Social Media and Digital Platforms, Freelance Writing

Total: 30 Hours

Course Outcomes:

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

CO1: demonstrate proficiency in language use.

CO2: master the nuances of Spoken and Written Communication skills in professional contexts.

CO3: develop confidence and clarity in Professional English usage.

CO4: organize their ideas coherently in writing for formal contexts.

CO5: exhibit their oral and written communication skills for professional contexts such as presentations and meetings.

Reference Books:

1. Professional English by Meenakshi Raman and Sangeetha Sharma -2018.
2. General English for all competitive examinations by S.C.Gupta -2016.
3. Ibbotson, Mark. *Professional Englishin Use: Engineering: Technical English for Professionals, Cambridge University, 2009*
4. Ruiz-Garrido, Miguel F., Juan C. Palmer-Silveira, and Inmaculada Fortanet-Gómez, eds. *English for professional and academic purposes*. Vol. 22. Amsterdam: Rodopi, 2010.

24EVS041 **ENVIRONMENTAL STUDIES**

L	T	P	O	C
3	0	0	2	3

Course Objective

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

UNIT-I HUMAN COMMUNITIES AND THE ENVIRONMENT 9

The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment;

Environmental Ethics and emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.

UNIT II NATURAL RESOURCES AND SUSTAINABLE DEVELOPMENT 9

Renewable and non-renewable resources - Natural resources and associated problems. a) Forest resources b) Water resources c) Mineral resources d) Food resources e) Energy resources: f) Land resources; Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

UNIT-III ECOSYSTEM AND BIODIVERSITY 9

Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics-forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services-classification and their significance.

Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. Major conservation policies: in-situ and ex-situ conservation approaches;

UNIT-IV ENVIRONMENTAL POLLUTION AND HEALTH 9

Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution; Causes, effects and control measures of a) Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards. Solid waste Management. Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

UNIT-V ENVIRONMENTAL TREATIES AND LEGISLATION **9**

Major International Environmental Agreements: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer;

Environmental laws:

Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act - Issues involved in enforcement of environmental legislation. Public awareness.

Total: 45 hours

Course Outcomes (CO): At the end of this course, learners will be able to:

Course Outcomes		K Level
CO1:	Gain insights into the international efforts to safeguard the Earth's environment and resources.	**K2**
CO2:	Understand the concept of natural resources; identify types of natural resources, their distribution and use with special reference to India.	**K4**
CO3:	Understand the concepts of ecosystems, biodiversity and conservation.	**K1**
CO4:	Sensitize themselves to adverse health impacts of pollution.	**K3**
CO5:	Understand the sectoral effects on the local, regional, and global environmental issues	**K2**

TEXT BOOKS

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.

2. William P. Cunningham and Mary Ann Cunningham, Environmental Science: A Global Concern 14th Edition, 2021.
3. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
4. Climate change: Science and politics (2021), Centre science and Environment, New Delhi,

REFERENCE BOOKS

1. Daniel B. Botkin and Edward A. Keller, **Environmental Science: Earth as a Living Planet,** 9th Edition, New Age International 2022.
2. Jadhav H and Bhosale VM, Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs 2023.

WEB LINK

1. *HTTPS://EASYENGINEERING.NET/GE6351-ENVIRONMENTAL-SCIENCE-AND/*
2. *HTTPS://LEARNENGINEERING.IN/GE8291-ENVIRONMENTAL-SCIENCE-AND-ENGINEERING*
3. https://cpcb.nic.in/ standards/

24CBIA41 **PROGRAMMING IN PERL**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, Be aware of the important topics and principles of software development.

UNIT I INTRODUCTION TO PERL 09

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

UNIT II EXPRESSIONS AND FILES 09

Operators and Expressions: Arithmetic Expressions, Evaluation of Expressions, Arithmetic operator Precedence, Mathematical Functions. Decision Making and Branching: - if, if…Else, nesting of if…else, else if ladder and Switch statement, the ?: operator, Decision Making and Looping: - while, Do While and For statements, Jumps in Loops and Labeled Loops, Classes, Objects and Methods: - Defining a Class, fields declaration, methods declaration, creating objects, accessing class members, Constructors, methods overloading, Extending a Class (Inheritance), Overriding Methods, final variables and methods, final classes.

UNIT III OPERATORS 09

sequences and strings: - Representing Sequence Data, A Program to Store a DNA Sequence, Concatenating DNA Fragments Transcription: DNA to RNA, Using the Perl Documentation, Calculating the Reverse Complement in Perl, Proteins, Files, and Arrays, Reading Proteins in Files, Arrays Scalar and List Context.

UNIT IV CONTROL STRUCTURES 09

Perl control structures: if, elsif, else, unless, while, do-while, until, do-until, for and foreach - Finding Motifs, Counting Nucleotides, simple program. Motif discovery in large datasets: deep learning and HMMs (Hidden Markov Models).

UNIT V PACKAGES, MODULES AND BIOPERL 09

Introduction to BioPerl and its applications, understanding BioPerl modules such as Bio::Seq, Bio::SeqIO, Bio::PrimarySeq, Bio::Search, and Bio::DB. subroutines and their scoping, effective use of modules and libraries of subroutines, and techniques for identifying and fixing bugs in BioPerl code.data manipulation, and sequence analysis using BioPerl tools

Total: 45 Hours

COURSE OUTCOMES:

CO-1: Write and execute a script in Perl.

CO-2: Able to formulate stepwise implementation of a Perl script using Expressions and Files

CO-3: To learnt how to utilize the operators and arrays to analyse the sequence data

CO-4: To write the program to find the motif using control structures.

CO-5: Enable routine and module calls and their implementation using Bioperl.

CO-6: To detect and resolve issues in BioPerl scripts.

CO-7: Utilize Bio::Graphics to create graphical representations of sequences.

TEXT BOOKS:

- Martin C Brown, 2021, “Perl the Complete Reference”, Second Edition, Tata McGrawHill,

REFERENCE BOOKS:

- Erick Storm, 1998, “Perl CGI Programming”, BPB Publication.
- Steven Holzner, 2017 “Per: Black Book”, Second Edition, Dreamtech Publication.
- Ed Peschko& Michele Dewolf, 2000, “Perl Developer’s Guide”, Tata McGraw Hill.

WEB RESOURCE LINK:

- https://in.search.yahoo.com/search?fr=mcafee&type=E210IN885G0&p=Learn+Perl+-+Perl.org

24CBIA42 **PHYTOCHEMISTRY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES

The primary objectives of this course are to:

1. Introduce the fundamentals of phytochemistry – Explain the classification, biosynthesis, and significance of plant-derived secondary metabolites.
2. Teach extraction and isolation techniques – Provide knowledge on various methods used to extract, isolate, and analyze bioactive compounds from plants.
3. Familiarize students with structural characterization – Introduce spectroscopic and computational techniques for identifying and studying phytochemicals.
4. Explore the pharmacological importance of phytochemicals – Discuss the biological activities of plant-derived compounds and their role in drug discovery and human health.
5. Integrate bioinformatics with phytochemistry – Explain how computational tools and databases aid in analyzing phytochemicals, predicting their drug-like properties, and accelerating herbal drug discovery.

By the end of this course, students will be equipped with both theoretical and practical knowledge of phytochemistry, along with an understanding of its applications in bioinformatics, pharmacy, and drug discovery.

UNIT 1: INTRODUCTION TO PHYTOCHEMISTRY 09

Definition, scope, and importance of phytochemistry, Classification of plant secondary metabolites: Alkaloids, Flavonoids, Terpenoids, Phenolics, Glycosides, and Saponins, Role of secondary metabolites in plant defense and human health, Overview of plant biosynthetic pathways (shikimate, mevalonate, and acetate pathways)

UNIT 2: EXTRACTION AND ISOLATION OF PHYTOCHEMICALS 09

Collection and processing of plant materials, Methods of extraction: Maceration, Soxhlet extraction, Sonication, Microwave-assisted extraction, Supercritical fluid extraction, Preliminary phytochemical screening tests, Isolation techniques: Chromatographic techniques (TLC, HPTLC, Column Chromatography, GC, HPLC)

UNI T 3: STRUCTURAL CHARACTERIZATION OF PHYTOCHEMICALS 09

Spectroscopic techniques: UV-Vis, FTIR, NMR, Mass Spectrometry, Applications of bioinformatics tools in phytochemical analysis (PubChem, ChemSpider, SwissADME), Structure-

activity relationship (SAR) of phytochemicals, Computational approaches in phytochemical research (molecular docking and molecular dynamics simulations)

UNIT 4: PHARMACOLOGICAL AND MEDICINAL PROPERTIES OF PHYTOCHEMICALS 09

Antioxidant, anti-inflammatory, antimicrobial, anticancer, and neuroprotective activities of phytochemicals, Phytochemicals as drug leads, Toxicity and safety evaluation of phytochemicals, Traditional vs. modern approaches in herbal drug formulation

UNIT 5: APPLICATIONS OF PHYTOCHEMISTRY IN BIOINFORMATICS AND DRUG DISCOVERY 09

Databases for phytochemicals: IMPPAT, Dr. Duke's Phytochemical Database, NPASS, Pubchem, SMILES, Computational drug discovery: Docking and ADMET predictions for phytochemicals, Role of machine learning and AI in phytochemical research, Future prospects of phytochemistry in personalized medicine and nutraceuticals.

Total Hours -45 Hours

COURSE OUTCOMES

- CO1: Describe the fundamental concepts of phytochemistry, including plant secondary metabolites and their classification.
- CO2: Explain various extraction and isolation techniques used in phytochemical studies.
- CO3: Apply spectroscopic and computational techniques to analyze phytochemicals and determine their structural properties.
- CO4: Analyze the pharmacological properties of phytochemicals and their role in drug discovery.
- CO5: Evaluate the safety, efficacy, and bioavailability of phytochemicals using bioinformatics tools.
- CO6: Design computational approaches for phytochemical research, including molecular docking and ADMET predictions.
- CO7: Integrate phytochemical data from databases and computational models to develop novel herbal drug formulations.

TEXTBOOKS:

1. Harborne, J. B. (1998). "Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis." Springer.
2. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2019). "Pharmacognosy." Nirali Prakashan.
3. Sarker, S. D., Latif, Z., & Gray, A. I. (2005). "Natural Products Isolation." Humana Press.

4. Sunil Dutt, Dr. Rajesh Kumar, and Pankaj Kali**a** (2024), *A Text Book of Pharmacognosy and Phytochemistry-I*, Bright Sky Publications, New Delhi, India.

REFERENCE BOOKS:

1. Tiwari, P. (2011). "Phytochemical Screening and Extraction: A Review." Pharmacognosy Reviews.
2. Cseke, L. J., Kirakosyan, A., Kaufman, P. B., Warber, S., Duke, J. A., & Brielmann, H. L. (2016). "Natural Products from Plants." CRC Press.
3. Guleria, S., & Kumar, A. (2021). "Phytochemicals in Drug Discovery and Development." Springer.
4. Mital Kaneria and Kalpna Rakholiya (Eds.) (2024), *Herbal Formulations, Phytochemistry and Pharmacognosy*, Elsevier Science, Amsterdam, Netherlands.

WEB LINK:

1. https://studyfrnd.com/a-textbook-of-pharmacognosy-pdf-books/?utm_source

24DBIA4_ **GENOMICS AND PROTEOMICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: This course will enable the students to appreciate the importance and understanding of full genome and to explore the genomics databases & various algorithms used for comparisons of full genome and gene order. It also useful for understanding the concepts of SNPs and their significance with increase in value of proteomics concepts and technology.

UNIT I INTRODUCTION TO GENOMICS **12**

Definition of Genome, genome composition, Genome Mapping- Genetic Mapping- linkage Analysis-Physical Mapping- Restriction mapping, Genetic Variations- SNP, SSCP, DNA Marker-Restriction Fragment Length Polymorphism, (RFLP), DNA Fingerprinting, VNTR, Minisatellites, Locating Genes in DNA sequence- FISH, Chromosome Walking.

UNIT II FUNCTIONAL GENOMICS **12**

Functional genomics: Human Genome Project-protein-nucleic acid interactions, RNA interference, Microarrays, DNA Sequencing – Maxam Gilbert and Sanger's methods, Next Generation Sequencing technologies, whole genome sequencing, Introduction to Epigenetics and Metagenomics.

UNIT III STRUCTURAL GENOMICS **12**

Structural Genomics- Comparative Genomics, Genome Annotation- Structural Annotation, Functional Annotation, Gene Finding, Gene prediction in prokaryotes, Gene prediction in eukaryotes, UCSC Genome Browser.

UNIT IVPROTEOMICS **12**

Proteomics- Introduction, Protein detection & Methods of Analysis of Proteins, Protein purification and Separation techniques, Proteome analysis using 2D PAGE electrophoresis.

UNIT V PROTEIN CHARACTERIZATION **12**

Protein characterization – MALDI-TOF and Peptide mass finger printing, Protein sequencing, Protein-protein interactions (Two hybrid interaction screening), Protein arrays, Applications of proteome analysis to drug development. Protein structure Databases: PDB, PIR, Structural Classification- SCOP and CATH. Protein visualization tools Swiss PDB viewer, EXPASY proteomic tools, Amino acid: Structure and Properties of Amino acids- Hydrophobicity, EIIP, Molecular weight.

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: To acquire the knowledge Genome and its function.
- CO-2: To learnt about the various sequencing methods and by studying its activity for

predicting the structure of known genes.

- CO-3: To annotate and analyse the functional types of the various genes.
- CO-4: To acquire the knowledge proteomics and its function using invitro techniques.
- CO-5: To analyse the sequence and structure of protein through insilico analysis.
- CO6: Utilize bioinformatics tools such as Swiss PDB Viewer and EXPASY for protein structure visualization and classification.
- CO7**:** Evaluate the role of proteomics in drug development and protein-protein interactions using techniques like two-hybrid screening and protein arrays.

TEXT BOOKS:

1. David W. Mount, 2001, "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press.

REFERENCE BOOKS:

1. **Arthur Lesk** (2025), Introduction to Genomics, 4th Edition, Oxford University Press, Oxford, UK..
2. **Josip Blonder (Ed.)** (2024), *Proteomics for Drug Discovery*, Methods in Molecular Biology, Volume 2823, Humana Press, New York, NY, USA.
3. S.R.Pennigton and M.J.Dunn, 2002 "Proteomics", Viva Books Private Limited. New Delhi,.

WEB RESOURCE LINKS:

1. https://www.ebi.ac.uk/training/online/courses/proteomics-an-introduction/

24DBIA4_ **MOLECULAR MICROBIAL PATHOGENESIS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: To describe some of the various activities of microorganisms that are beneficial to humans, some staining techniques and to define the science of microbiology and describe some of the general methods used in the study of microorganisms.

UNIT I AN OVERVIEW **12**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 12

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS **12**

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens: Enterotoxigenic E.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative E.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular

stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 12

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses.

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS 12

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: List the scientific accomplishments of Louis Pasteur and Robert Koch.
- CO-2: Describe the aspects on the various pathogen types and their modes of entry in to the host.
- CO-3: Explain the details about the signal transduction process.
- CO-4: Compare the attributes about the virulence assays.
- CO-5: Analyze the new therapeutic strategies.
- CO-6: Examine the interactions between pathogens and host immune systems.
- CO-7: Evaluate how pathogens evade host defenses and establish infections.

TEXT BOOKS:

1. Iglewski B.H and Clark V.L “Molecular basis of Bacterial Pathogenesis”, Academic Press, 2019.
2. Peter Williams, Julian Ketley & George Salmond, “Methods in Microbiology: Bacterial Pathogenesis, Vol. 27”, Academic Press, 2018.. Pearson, San Francisco, CA. 11th ed.+ ,2018.

REFERENCE BOOKS:

1. Recent reviews in Infect. Immun., Mol. Microbiol, Biochem. J., EMBO etc.
2. Nester, Anderson, Roberts, Pearsall, Nester, “Microbiology: A Human Perspective”,

McGraw-Hill, 3rd Edition, 2021.

3. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2021.

WEB RESOURCE LINKS:

1. http://www.microbeworld.org/
2. https://www.asm.org/
3. http://commtechlab.msu.edu/sites/dlc-me/zoo/

24PBIA41 **PROGRAMMING IN PERL PRACTICAL V**

L	T	P	O	C
0	0	2	1	1

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

1.Write a simple Perl program to get a DNA sequence and print. **03**

2.Write a Perl program demonstrate joining two strings. **03**

3.Write a Perl program to demonstrate Array Handling in Perl. **03**

4.Write a Perl program to demonstrate printing array in different ways. **03**

5.Write a Perl program to demonstrate Array creation by splitting. **03**

6.Write a Perl program to demonstrate Hash Tables using nucleotide bases. **03**

7.Write a Perl program to demonstrate assignment operators in Perl. **03**

8.Write a Perl program to demonstrate conditional operators in Perl. **03**

9.Write a Perl Program to finding the reverse complement of a DNA sequence **03**

10.Write a Perl Program to swap two values using subroutines. **03**

Total:30 Hours

COURSE OUTCOMES:

- CO-1: To write the program to analyze the length of the given sequences.
- CO-2: Able to formulate stepwise implementation of a Perl script using Expressions and Files
- CO-3: To learnt how to utilize the operators and arrays to analyse the sequence data.
- CO-4: To learn how to write reverse complement to access data in Perl programs.
- CO-4: To learn how to write swap two values using subroutines in Perl.
- CO-5: To learn how to use demonstrate Hash Tables using nucleotide bases.

TEXT BOOKS:

1. Martin C Brown, “Perl the Complete Reference”, Second Edition, Tata McGraw Hill, 2015.

REFERENCE BOOKS:

1. Erick Storm, “Perl CGI Programming”, BPB Publication, 1998.
2. Steven Holzner, “Per: Black Book”, Second Edition, Dreamtech Publication, 2017.

WEB RESOURCE LINKS:

1. https://perldoc.perl.org/

L	T	P	O	C
0	0	2	1	1

24PBIA42 PHYTOCHEMISTRY PRACTICAL VI

COURSE OBJECTIVES: This understanding is fundamental to allow efficient exploitation of plants as biological resources in the development of new cultivars with improved quality and reduced economic and environmental costs. This knowledge is also vital for the development of new plant diagnostic tools. To understand the genetic and molecular basis of all biological processes in plants those are relevant to the specie.

1.	Literature Survey for the identification on the compound present in the plant using IMPPAT	**03**
2.	Retrieving the SMILES of the plant compound.	**03**
3.	Draw the structure of the plant the compound.	**03**
4.	Retrieving the Physicochemical Properties of the plant the compound	**03**
5.	Retrieving the Lipophilicity of the plant the compound	**03**
6.	Retrieving the Water Solubility of the plant the compound	**03**
7.	Retrieving the Pharmacokinetics of the plant the compound	**03**
8.	Retrieving the Medicinal Chemistry	**03**
9.	Toxicity prediction using Bioinformatics tools	**03**
10.	Molecular Docking Analysis of Bioactive Compounds Using ArgusLab	**03**

Total: 30 Hours

COURSE OUTCOMES:

- CO-1: To understand the plant cell structure and their morphogenesis.
- CO-2: To acquire the concepts of plant growth using the hormonal actions.
- CO-3: To study plant natural products and chemical properties.
- CO-4: To acquire the knowledge of basics of Pharmacognosy.
- CO-5: To study the herbal preparations and isolation techniques.

TEXT BOOKS:

1. Dr. Ankit Kumar Saini et al., (2024), *Textbook of Pharmacognosy and Phytochemistry-I*, Shashwat Publication, New Delhi, India.

REFERENCE BOOKS:

1. Mital Kaneria and Kalpna Rakholiya (Eds.) (2024), Herbal Formulations, Phytochemistry and Pharmacognosy, Elsevier Science, Amsterdam, Netherlands.
2. Jean Bruneton (2024), *Pharmacognosy, Phytochemistry, Medicinal Plants*, Lavoisier, Paris, France.

WEB RESOURCE LINKS:

1. https://www.arabidopsis.org/

24SBIA41 **INDUSTRY ORIENTED EMPLOYABILITY SKILLS**

L	T	P	O	C
1	0	2	1	2

COURSE OBJECTIVES

1. To equip students with industry-ready laboratory and computational skills required in biotech, pharma, clinical research, and bioinformatics sectors.
2. To build strong resume writing, technical documentation, and scientific communication capabilities.
3. To enhance problem-solving, analytical thinking, and data interpretation aligned to real-time industry challenges.
4. To develop practical job search strategies, interview skills, and professional behaviour for workplace success.
5. To improve teamwork, leadership, and project execution abilities with hands-on mini-projects.

UNIT I – INDUSTRY EXPECTATIONS & WORKPLACE READINESS 6 Hours

Overview of **Biotech, Pharma, Diagnostics, Healthcare & Bioinformatics** industries

- Employee/Employer expectations
- Good Laboratory Practices (GLP)
- Good Documentation Practices (GDP)
- Growth chart & Career pathways in industry
- Hierarchy, escalation matrix & departmental structure
- Understanding **company culture, ethics & compliance**

UNIT II – CORE TECHNICAL & INDUSTRY SKILLS 6 Hours

Biotechnology/Diagnostics Skills

- Aseptic techniques, pipetting, lab safety
- PCR, qPCR, RT-PCR basics
- NGS workflow overview
- Basic microbiology & molecular diagnostics
- Cell culture fundamentals
- SOP writing & data recording

Bioinformatics Skills

- Introduction to Linux/Command-line
- Sequence analysis (BLAST, FASTA, ORF prediction)
- Genome annotation basics
- Database usage: NCBI, EMBL-EBI, UniProt
- Basics of Python/R for biology
- Data visualization concepts

UNIT III – JOB PREPAREDNESS & PROFESSIONAL BRANDING 6 Hours

- Resume, CV, and Bio-data preparation (Biotech/Bioinformatics targeted)
- Writing industry-style project summaries
- LinkedIn optimisation for life science students
- Using social media for professional presence
- Email etiquette for scientific communication
- Writing an impactful cover letter (Industry-specific)

UNIT IV – INTERVIEW & TECHNICAL ASSESSMENT SKILLS 6 Hours

Types of interviews: HR, Technical, Panel, Virtual

- Biotech & Bioinformatics technical interview question patterns
- Dress code & professional attire for lab/office environments
- Group discussion (scientific topics)
- "Sell Yourself" – how to present your skills confidently
- Problem-solving and case-study based questions
- Portfolio creation (mini-projects, coding assignments, lab work)

UNIT V – PRACTICALS, MINI-PROJECT & VIVA 6 Hours

Mock Group Discussion

- Mock Interviews (Technical + HR)
- Hands-on resume correction session
- Mini project (choose any one):
  - Small bioinformatics data analysis task
  - Lab skill demonstration project
  - Literature review & presentation
- Final viva voce with project presentation

Total Hours- 30 Hours

COURSE OUTCOMES

CO1: Students will be able to create **professional resumes** and perform confidently in interviews.
CO2: Demonstrate effective **scientific communication** and presentation skills.
CO3: Work collaboratively in teams and execute mini-projects effectively.
CO4: Apply **critical thinking and problem-solving** to biotech/bioinformatics industry challenges.
CO5: Display strong **professional behaviour, workplace ethics, and adaptability**.
CO6: Gain essential hands-on exposure to **lab skills and bioinformatics tools** expected by industry recruiters.

REFERENCES

- "Bioinformatics Algorithms" – Pavel Pevzner

- "Molecular Biology Techniques: A Classroom Laboratory Manual" – D. Micklos
- "Cracking the Biotech Job Market" – Paperback edition
- "What to Say in Every Job Interview" – Don Georgevich
- Industry SOP manuals & GLP/GDP guidelines (WHO, ICH)

L	T	P	O	C
0	0	2	1	1

24DVAC4_ **YOGA EDUCATION**

COURSE OBJECTIVE

The students will be able to:

- Understand the philosophy, aims, and health benefits of Yoga.
- Gain practical knowledge of yogic postures, breathing techniques, and relaxation practices.
- Apply yogic methods for stress reduction, emotional balance, and focus enhancement.
- Incorporate Yoga as a tool for lifestyle improvement, well-being, and inner awareness.

UNIT-I INTRODUCTION TO YOGA 5

Definition and meaning of Yoga – Classical and modern perspectives. -Philosophy and objectives of Yoga-Benefits of Yoga for physical, mental, and emotional health -Relevance of Yoga in daily life, especially for students and professionals - Guidelines for safe and mindful Yoga practice

UNIT II YOGA PRACTICES – ASANAS AND BREATHING 5

Loosening and warm-up exercises Neck, shoulder, spine, and joint movements - Standing AsanasTadasana, Trikonasana, Vrikshasana - Sitting AsanasVajrasana, Ardha Matsyendrasana, Bhadrasana - Prone and Supine AsanasBhujangasana, Shalabhasana, Pavanamuktasana - Breathing Practices (Pranayama)Anulom Vilom, Bhramari, Sheetali, Sheetkari - Relaxation TechniquesDeep Relaxation Technique (DRT)

UNIT-III YOGA FOR MENTAL WELL-BEING & LIFESTYLE MANAGEMENT 5

Ecosystems and ecosystem services: Major ecosystem types in India and their basic Role of Yoga in managing stress, anxiety, and fatigue - Importance of meditation and breath regulation - Basics of meditation: breath-based and mindfulness - Yogic lifestyle guidelines – diet, discipline, sleep, and conduct - Integrating Yoga into student routine for balance and productivity

Total: 15 hours

Course Outcomes (CO): At the end of this course, learners will be able to:

Course Outcomes	
CO1:	Explain the meaning and relevance of Yoga for overall well-being.
CO2:	Demonstrate basic asanas and breathing techniques with proper alignment.
CO3:	Practice guided relaxation and introductory meditation.

TEXT BOOKS & REFERENCE BOOKS

1. Ministry of AYUSH. (2023). Common Yoga Protocol. Government of India
2. Swami Satyananda Saraswati. Asana, Pranayama, Mudra, Bandha. Bihar School of Yoga
3. Dr. R. Nagarathna & Dr. H. R. Nagendra. Yoga for Students. SVYASA
4. NCERT. (2020). Yoga – A Healthy Way of Living (Upper Primary and Secondary)

24DVAC4_ **NATIONAL SERVICE SCHEME**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES:

The students will be able to understand the concept of youth and the importance of youth population in Nation Building. The course also enable the students to appraise the nature and growth of national service scheme in India. The course enable the students to perceive the aims, objectives, logo, emblem and organizational structure of NSS.

UNIT-I INTRODUCTION 05

Introduction to National Service Scheme. Philosophy of NSS. Basic concepts of NSS-Motto, Symbol, Badge, NSS Day. NSS programs and activities; NSS Components-Programme Officer, Volunteer, Community. Classification of NSS Programme.

UNIT-II ACTIVITIES OF NSS 05

Regular activities of NSS – Adoption of villages, slums etc., Coordination with Voluntary Organizations, National Service Volunteer Scheme (NSVS), Day Camps, Special Camping Program-objectives, contributions and activities.

UNIT-III ADMINISTRATION, PLANNING & IMPLEMENTATION OF NSS PROGRAMS 05

Administrative structure of NSS at National, State and University levels. NSS advisory committees. Planning and Implementation of NSS Programs-Off campus activities- Rally, Swatchatha Programme, Visit to heritage sites, conserving ancient monuments, Women empowerment program, Blood donation, Water conservation program etc.

Total Hours: 15

Course Outcome

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

CO1: To explain the philosophy and basic concepts of NSS.

CO2: To appraise the activities of NSS.

CO3: To discuss the concepts of Special Camping Program.

Textbooks

1. National Service Scheme Manual (Revised), (2006), Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. Afsal Mohammad B, (2020), An introduction to volunteerism in India.

SEMESTER V

24CBIA51 **SYSTEMS BIOLOGY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: To know Advanced Measurement Systems, Introduction to Biological Networks and Basic Concepts, Systems biology software project. Analyze factors involved in Biological System Design. Understand and apply the bioinformatics tools for computational Biology and Systems Biology applications. Typically focuses on applying MATLAB tools and programming techniques to analyze biological data. To evaluate and indicate the conserved motifs in DNA/protein sequences.

UNIT I INTRODUCTION AND BIOLOGICAL NETWORKS 09

Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems - Introduction to Biological Networks and Basic Concepts – Metabolic, Signaling and Regulatory networks - Why build and study models? - Characterizing dynamic states - Formulating and studying dynamic network models - Properties of dynamic states - Network structure versus dynamics. Graph Neural Networks (GNNs) to model signalling, regulatory, or metabolic networks. Network topology mining: Cytoscape with machine learning plugins- gene knockouts, drug interventions.

UNIT II STANDARD MODELS AND APPROACHES IN SYSTEMS BIOLOGY 09

Metabolism- enzyme kinetics and thermodynamics- Michaelis-Menten Kinetics - metabolic networks- metabolic control analysis - Signal transduction- introduction- function and structures- interactions- structural components - signaling selected biological processes - mathematical models - prediction of biological systems. Modeling Enzyme Kinetics: machine learning- regression models, predict reaction rates. Predicting Biological System Behavior: supervised learning – Support Vector Machine and Random Forests.

UNIT III E-CELL PROJECT 09

E-CELL: Organization - History - Research group - modeling methods – formalism - techniques numerical simulation algorithm-mathematical analysis methods-software environment-projects models-applications chemotaxis - molecular clock-circadian rhythms-oxidation stress-multi-enzyme systems. Reinforcement learning, E-Cell simulations- gene expression time series. AI-based classifiers: Detect periodicity and predict oscillatory.

UNIT IV MATLAB FOR BIOINFORMATICS 09

MATLAB + Artificial Intelligence Toolboxes: Classification of DNA sequences, Clustering gene expression profiles and Predictive modeling of metabolic networks. Cytoscape & BioSpice – Machine Learning plugins.

UNIT V SEQUENCE AND STRUCTURE ANALYSIS 09

Sequence alignment -pairwise and multiple sequence alignment, Pattern matching and motif finding, Phylogenetic tree construction. Protein structure visualization, Molecular modeling and docking, Interaction networks and systems biology. Computational and Theoretical Tools – Genomics, Proteomics and Metabolomics Tools - Applications in Synthetic Biology – Molecular, Pathway and Whole Cell Levels - Challenges and Future Perspectives. Machine Learning-enhanced molecular docking for drug discovery and evolutionary relationships.

Total: 45

Hours

COURSE OUTCOMES:

CO-1: Understand and explain high throughput measurements of biological systems.

CO-2: Analyze factors involved in Biological System Design.

CO-3: Model prokaryotic gene expression

CO-4: Utilize systems biology tools such as E-Cell and V-Cell Utilize systems biology tools such as MATLAB and Image processing

CO-5: Understand and apply the principles of Synthetic Biology and Systems Biology applications.

Understand and apply the bioinformatics tools for computational Biology and Systems Biology applications.

CO-6: Typically focuses on applying MATLAB tools and programming techniques to analyze biological data.

CO-7: To evaluate and indicate the conserved motifs in DNA/protein sequences.

TEXT BOOKS:

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press, 2021.
2. Bernhard O. Palsson, Systems Biology – Simulation of Dynamic Network States, Cambridge Univ. Press, UK,2015.

REFERENCE BOOKS:

1. E.Klipp, et al. Systems Biology in Practice, Wiley-VCH, Weinheim, 2005.

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

WEB RESOURCE LINKS:

1. www.systems-biology.org/

24CBIA52 PROGRAMMING IN PYTHON FOR BIOINFORMATICS

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES:

To introduce students to Python programming with a focus on bioinformatics applications. To develop skills in handling biological data using Python. To learn about functions, file handling, and modules for bioinformatics analysis. To implement sequence analysis and explore biological databases using Python.

UNIT I: INTRODUCTION TO PYTHON AND BASIC CONCEPTS 09

History and Features of Python, setting up the Python environment, Writing and executing Python programs, Values, Variables, and Data Types, Keywords, Identifiers, and Naming Conventions, print() function and Output Handling, Statements, Indentation, and Comments, Understanding Namespaces in Python, Artificial Intelligence & Machine Learning frameworks - TensorFlow, PyTorch, and Scikit-learn. exploratory data analysis (EDA), model prototyping in data science - Jupyter.

UNIT II: EXPRESSIONS, DATA HANDLING, AND FILE OPERATIONS 09

Operators and Expressions: Arithmetic, Logical, and Relational Operators, Operator Precedence and Associativity, Errors and Exception Handling: Syntax, Runtime, and Logic Errors, Data Types and Type Conversion, Input and Output Functions (input(), print()), File Handling in Python: Reading and Writing Files, File Methods and Directory Management: Introduction to Handling Bioinformatics Data (FASTA, GenBank files), Building datasets for machine learning, parse datasets, model training and prediction.

UNIT III: CONTROL STRUCTURES AND LOOPS 09

Conditional Statements: if, if-else, elif Statements, Looping Structures: for and while Loops, Nested Loops and Loop Control (break, continue, pass), Infinite Loops and Their Handling, Iterating Over Biological Sequences (DNA, RNA, Protein), Machine Learning models- training and testing set preparation.

UNIT IV: FUNCTIONS, MODULES, AND LIBRARIES 09

Functions in Python: Built-in vs. User-defined Functions, Function Arguments and Return Statements, Scope of Variables (Local, Global, Nonlocal), Recursive Functions, Introduction to Python Modules and Libraries: Importing Modules and Using Built-in Functions, dir() Function and Module Search Path. Data cleaning, Feature engineering and Statistical analysis: NumPy and Pandas.

UNIT V: BIOINFORMATICS APPLICATIONS USING PYTHON 09

Introduction to BioPython and Its Applications, Sequence Analysis Using Python: Reading and Parsing Biological Sequences (FASTA, BLAST, GenBank), Sequence Alignment and Manipulation, Fetching Data from Biological Databases (NCBI, UniProt), Phylogenetic Tree Construction with Python, Introduction to Data Visualization in Bioinformatics (Matplotlib). Clustering algorithms trained with Artificial Intelligence, plotting model performance: ROC curves - confusion matrix.

COURSE OUTCOMES:

CO1: Explain the fundamentals of Python, including its syntax, variables, and data types.

CO2: Apply expressions, operators, file handling techniques, and error handling in Python.

CO3: Implement control structures such as conditional statements and loops for iterative computations.

CO4: Develop Python functions and utilize built-in and user-defined functions for modular programming.

CO5: Use Python modules and libraries like NumPy, Pandas, and BioPython for data handling.

CO6: Perform sequence analysis, manipulate biological data, and retrieve data from biological databases.

CO7: Design bioinformatics applications using Python for data visualization and analysis.

TEXTBOOKS:

1. Mitchell L. Model (2024), Bioinformatics Programming Using Python: Practical Programming for Biological Data, O'Reilly Media, Sebastopol, CA, USA.Deitel, P. J., & Deitel, H. (2020). Python for Programmers (1st ed.). Pearson.
2. Kinser, J. (2019). Python for Bioinformatics (2nd ed.). Jones & Bartlett Learning.
3. Hasija, Y., & Munjal, P. (2022). Bioinformatics with Python Cookbook (2nd ed.). Packt Publishing.

REFERENCE BOOKS:

1. Antão, T. (2018). Bioinformatics with Python Cookbook (2nd ed.). Packt Publishing.
2. Baxevanis, A. D., & Ouellette, B. F. F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (3rd ed.). Wiley.
3. Biopython Project (2024), *Biopython: Python Tools for Computational Biology*, Open Bioinformatics Foundation.Sweigart, A. (2019). Automate the Boring Stuff with Python (2nd ed.). No Starch Press.

WEB LINK:

1. https://www.oreilly.com/library/view/bioinformatics-programming-using/9780596804725/

24DBIA5 **CANCER BIOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

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

UNIT I FUNDAMENTALS OF CANCER BIOLOGY 12

Regulation of Cell cycle- Mutations that cause changes in signal molecules- effects on receptor-signal switches- tumor suppressor genes- Modulation of cell cycle-in cancer- Different forms of cancers- Diet and cancer.

UNIT II PRINCIPLES OF CARCINOGENESIS 12

Chemical Carcinogenesis- Metabolism of Carcinogenesis- Natural History of Carcinogenesis- Targets of Chemical Carcinogenesis- Principles of Physical Carcinogenesis- X-Ray radiation – Mechanism of radiation Carcinogenesis.

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 12

Oncogenes- Identification of Oncogenes- Retroviruses and Oncogenes- detection of Oncogenes- Growth factor and Growth factor receptors that are Oncogenes- Oncogenes / Proto Oncogenes activity- Growth factors related to transformations.

UNIT IV PRINCIPLES OF CANCER METASTASIS 12

Clinical significances of invasion- heterogeneity of metastatic phenotype- Metastatic cascade- Basement membrane disruption- Three step theory of invasion- Proteinases and tumor cell invasion.

UNIT V NEW MOLECULES FOR CANCER THERAPY 12

Different forms of therapy- Chemotherapy- Radiation Therapy- Detection of Cancers- Prediction of aggressiveness of Cancer- Advances in Cancer detection.

Total 60 hours

COURSE OUT COMES

CO-1: Learn the aspects of regulation of cell cycle.

CO-2: Describe the features of modulation of cell cycle-in cancer.

CO-3: List the details about Natural History of Carcinogenesis

CO-4: Demonstrate the mechanism of radiation Carcinogenesis.

CO-5: Explain the facts about three step theory of invasion.

CO-6: Define cancer and explain the process of carcinogenesis.

CO-7: Differentiate between benign and malignant tumors.

TEXT BOOKS:

1. Robin Hesketh. Introduction to Cancer Biology (2nd Edition), Cambridge University Press, 2023.
2. King R.J.B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K., 2015.
3. Ruddon.R.W.,*Cancer Biology*, Oxford University Press, Oxford, 2017.

REFERENCE BOOKS:

1. Maly B.W.J., *Virology a practical approach*, IRL press, Oxford, 1987.
2. Dunmock.N.J and Primrose S.B., *Introduction to modern Virology*, Blackwell Scientific Publications, Oxford, 1988.

WEB RESOURCE LINKS:

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

24DBIA5_ **UNIX PROGRAMMING**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: To acquaint the students with the basic internal structure & operations of UNIX operating system, able to develop system programs using system calls and to introduce utilities & Shell Programming. To provide introduction to UNIX Operating System and its File System To gain an understanding of important aspects related to the SHELL and the process. To develop the ability to formulate regular expressions and use them for pattern matching. To provide a comprehensive introduction to SHELL programming, services and utilities.

UNIT I INTRODUCTION TO UNIX 12

Introduction to Unix- Evolution and features- -Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving Multiple Commands.

UNIT II FILE ORGANIZATION 12

Files and File organization, The File system –The Basics of Files-Directories and File Names-Permissions-INodes-The Directory Hierarchy, File Attributes and Permissions-The File Command knowing the File Type-The Chmod-Command Changing File Permissions-The Chown-Command Changing the Owner of a File-The Chgrp-Command Changing the Group of a File.

UNIT III COMMAND LINE STRUCTURE 12

Using the Shell-PATH setting-Command Line Structure-Meta Characters-Creating New Commands-Command Arguments and Parameters-Program Output as Arguments- Shell Variables- -More on I/O Redirection-Looping in Shell Programs.

UNIT IV FILTERS AND FILES 12

Filters-The Grep Family-Other Filters-The Stream Editor Sed-The AWK Pattern Scanning and processing Language-Good Files and Good Filters.

UNIT V BRANCHING AND CONTROL STRUCTURES 12

Shell Programming-Shell Variables-The Export Command-The Profile File a Script Run During Starting-The First Shell Script-The read Command-Positional parameters-The $? Variable

knowing the exit Status-More about the Set Command-The Exit Command-Branching Control Structures-Loop Control Structures-The Continue and Break Statement-The Expr Command: Performing Integer Arithmetic-Real Arithmetic in Shell Programs-The here Document (<<)-The Sleep Command-Debugging Scripts-The Script Command-The Eval Command-The Exec Command.

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: Describe the architecture and features of UNIX Operating System and distinguish it from another Operating System
- CO-2: Demonstrate UNIX commands for file handling and process control
- CO-3: Write Regular expressions for pattern matching.
- CO-4: To apply them to various filters for a specific task
- CO-5: Analyse a given problem and apply requisite facets of SHELL programming in order to devise a SHELL script to solve the problem.
- CO-6: Write complex shell scripts to solve real-world problems.
- CO-7: Utilize AWK for text processing and report generation.

TEXT BOOKS:

1. Syed Mansoor Sarwar and Robert Koretsky.,UNIX: The Textbook, Third Edition, Chapman and Hall/CRC, 2020.
2. The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson.
3. Introduction to Unix Shell Programming by M.G. Venkatesh Murthy, Pearson.

REFERENCE BOOKS:

1. Unix and shell programming by B.M. Harwani, OXFORD university press.

WEB RESOURCE LINKS:

1. https://bioinformaticsworkbook.org/

L	T	P	O	C
0	0	2	1	1

24PBIA51 **SYSTEMS BIOLOGY PRACTICAL VII**

COURSE OBJECTIVE:

The objective of the Systems Biology Practical syllabus is to equip students with hands-on experience in analyzing and interpreting complex biological data through computational modeling and network analysis. Students will learn to construct and simulate gene regulatory networks, metabolic pathways, and protein-protein interaction networks using tools like Cytoscape, MATLAB, and Python. Additionally, they will gain proficiency in integrating multi- omics data, performing pathway enrichment analysis, and analyzing single-cell RNA sequencing data.

1. Gene Regulatory Network Analysis by Identify key regulatory genes based on network centrality measures. **03**

2. Metabolic Pathway Simulation using COBRApy (Python) to simulate the pathway under different conditions (e.g., different glucose levels). **03**

3. Protein-Protein Interaction Networks **03**

4. Dynamic Modeling of Biological Systems using an ODE model for a basic biological process, such as enzyme kinetics (Michaelis-Menten model) **03**

5. Whole-Genome Sequence Analysis by Providing a small dataset of sequence reads (FASTQ files) from a single gene. **03**

6. Functional prediction of hypothetical proteins using cdd and Pfa **03**

7. Homology modelling using Swiss model and model validation using saves. **03**

8. Use MATLAB to import and analyze DNA sequences. **03**

9. Visualize 3D structures of proteins using MATLAB **03**

10. Perform a simple docking study using MATLAB bioinformatics tools. **03**

Total: 30 Hours

COURSE OUTCOMES:

- CO-1: Understand and explain high throughput measurements of biological systems.
- CO-2: Analyze factors involved in Biological System Design
- CO-3: Model prokaryotic gene expression
- CO-4: Utilize systems biology tools such as E-Cell and V-Cell
- CO-5: Understand and apply the principles of Synthetic Biology and Systems Biology applications

- CO-6: Typically focuses on applying MATLAB tools and programming techniques to analyze biological data.
- CO-7: To evaluate and indicate the conserved motifs in DNA/protein sequences.

TEXT BOOKS:

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press,2021.
2. Bernhard Ø. Palsson, Systems Biology – Simulation of Dynamic Network States, Cambridge Univ. Press, UK,2020.
3. Singh, Gautam B. "Fundamentals of bioinformatics and computational biology." Cham: Springer International Publishing ,2015.

REFERENCE BOOKS:

1. E.Klipp, et al. Systems Biology in Practice, Wiley-VCH, Weinheim,2005.
2. Huimin Zhao (Ed.), Synthetic Biology: Tools and Applications, Academic Press, Elsevier, USA,2016.

WEB RESOURCE LINKS:

1. https://www.niaid.nih.gov/research/bioinformatics-resource-centers

L	T	P	O	C
0	0	2	1	1

24PBIA52 PROGRAMMING IN PYTHON FOR BIOINFORMATICS PRACTICAL VIII

COURSE OBJECTIVE:

This course aims to equip students with hands-on programming skills in Python, emphasizing problem-solving and real-world applications. Students will learn to write efficient, readable, and well-documented code, develop algorithms, and utilize libraries for data manipulation and analysis. By the end of the course, students will confidently implement Python programs to solve complex tasks and create functional software projects.

1. Write a Python program to demonstrate the basic I/O using interactive and batch mode **03**

2. Write a Python program to demonstrate the different string operations and methods. **03**

3. Write a Python program to demonstrate the basic operators. **03**

4. Write a Python program to demonstrate the searching, replacing, and parsing nucleotide text using regular expressions. **03**

5. Write a Python program to calculate the molecular weight of a double-stranded DNA. **03**

6. Write a Python program to calculate the bond length between two atoms in PDB file. **03**

7. Write a Python program to fetch a protein sequence, opening and finding the length of the SWISS-PROT database. **03**

8. Write a Python program to convert DNA to RNA using python **03**

9. Write a Python program to open a FASTA file of DNA Sequence. **03**

10. Write a Python program to find the GC content given sequence in the existing sequence. **03**

Total: 30 Hours

COURSE OUTCOMES:

- CO-1: Understand the Basics of Python Programming
- CO-2: Demonstrate the basic I/O using interactive and batch modes
- CO-3: To learnt how to utilize the different string operations and methods
- CO-4: Demonstrate searching, replacing, and parsing nucleotide text using regular expressions

- CO-5: To learn how to Calculate the molecular weight of a double-stranded DNA
- CO-6: Develop Python scripts to convert DNA to RNA, compute GC content, and perform other sequence-based bioinformatics analyses.
- CO-7: To Integrate biological knowledge with Python programming to solve real-time problems in molecular biology and biotechnology.

TEXT BOOKS:

1. Jason Kinser, "Python for Bioinformatics", Jones and Bartlett Publishers, Sudbury, Massachusetts,2019.

REFERENCE BOOKS:

1. Biopython Project (2024), *Biopython: Python Tools for Computational Biology*, Open Bioinformatics Foundation.
2. Kent D. Lee, "Python Programming Fundamentals: Second Edition", Springer, 2021.

***WEB RESOURCE LINKS*:**

1. https://www.bioinformatics.org/bradstuff/bp/tut/Tutorial.pdf

L	T	P	O	C
3	0	0	2	3

24EMDE51 **CYBER SECURITY**

COURSE OBJECTIVE

- To provide foundational knowledge of cyberspace, web technologies, and the evolving landscape of cyber security and its challenges.
- To familiarize students with the types of cyber crimes, legal frameworks including the IT Act 2000, and organizational measures for mitigating cyber threats.
- To equip students with practical understanding of securing digital devices, social media usage, e-commerce platforms, and digital payment systems.

UNIT I INTRODUCTION TO CYBER SECURITY 9

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

UNIT II CYBER CRIMEAND CYBER LAW 9

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with cyber crime and Cyber security in India, Case studies.

UNIT III SOCIAL MEDIA OVERVIEW AND SECURITY 9

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

UNIT IV E – COMMERCE AND DIGITAL PAYMENTS 9

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), eWallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital

payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payament Settlement Act,2007

UNIT V DIGITAL DEVICES SECURITY, TOOLS AND TECHNOLOGIES FOR CYBER SECURITY 9

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

COURSE OUTCOME

CO1: To explain the architecture of cyberspace, web technologies, and internet infrastructure with respect to cyber security.

CO2: To Identify various cyber crimes and evaluate legal remedies under the IT Act 2000 and associated cyber laws in India.

CO3: To Analyze the structure and impact of social media platforms and assess the security risks and legal implications of online content.

CO4: To understand e-commerce and digital payment mechanisms, including associated frauds, security practices, and relevant legal provisions.

CO5: To Apply cyber security tools and best practices for securing personal and organizational digital devices, networks, and systems.

TEXTBOOK/ REFERENCES

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition2010.

2. Cyber Security Understanding Cyber Crimes, Computer Forensics and LegalPerspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (FirstEdition, 2011)

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities byHenry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13thNovember, 2001)

4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.

5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, DominantPublishers.

6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition,Wiley India Pvt. Ltd.7. Fundamentals of Network Security by E. Maiwald, McGraw Hill

L	T	P	O	C
2	0	0	1	2

24SBIA51 **ENTERPRENEURIAL DEVELOPMENT**

COURSE OBJECTIVE:

To enrich the students towards the knowledge of entrepreneurial skills and to make the students understand the approaches to attain the goals of the business.

UNIT 1: INTRODUCTION TO ENTREPRENEURSHIP **06**

Introduction, Concept of Entrepreneur, Entrepreneurship and Enterprise, Definition of Entrepreneurship, Objectives of Entrepreneurship Development, Phases of Entrepreneurship Development, Role of Entrepreneurship, The Entrepreneurial Mindset, Characteristics of Entrepreneurship, Traits of Entrepreneurship, Introduction to Entrepreneurship Skills

UNIT 2: ENTREPRENEURSHIP DEVELOPMENT SKILLS **06**

Meaning of Entrepreneurship skill, Types of Entrepreneurship Skills: Business management skills, Teamwork and leadership skills, Communication and listening, Customer service skills, Financial skills, Analytical and problem-solving skills, Critical thinking skills, Strategic thinking and planning skills, Technical skills, Time management and organizational skills, Branding, marketing and networking skills, How to improve entrepreneurial skills, Entrepreneurial skills in the workplace.

UNIT 3: TYPES OF ENTREPRENEURS **06**

Classification and Types of Entrepreneurs; Women Entrepreneurs; Social Entrepreneurship; Corporate Entrepreneurs, Family Business: Concept, structure, and kinds of family firms; Culture and evolution of family firm; Managing Business.

UNIT 4: ENTREPRENEUR PROJECT DEVELOPMENT & BUSINESS PLAN **06**

Generation of Ideas-Innovation, Invention, Creativity, Business Idea and change. Idea generation. Kinds of Business Analysis-Concept of Environmental scanning and SWOT analysis. Business Planning Process-The business plan as an Entrepreneurial tool, scope and value of Business plan. Fundamental Elements of Business-Plan, Objectives, Market and Feasibility Analysis, Marketing, Finance, Organisation & Management and Ownership.

UNIT 5: MOBILIZING RESOURCES **06**

Resource Mobilization for entrepreneurship: Resources mobilization, types of resources, Process of resource mobilization, Arrangement of funds; writing a Funding Proposal, Traditional sources of financing, Venture capital, Angel investors, Business Incubators

Total: 30 Hours

COURSE OUTCOME:

At the end of the course, a student will be able to

CO1 T o Understand the concept of Entrepreneurship

CO2 To Identify, create and analyze entrepreneurial opportunities.

CO3 To Assess techno economic feasibility of a Business Plan

CO4 To Create Business Plans

CO5 To State various statutory institutions involved in the process of Entrepreneurship development

TEXT BOOKS:

1. Madhurima Lall and Sultan Ahmad (2021). Fundamentals of Entrepreneurship and Project Planning. S. Chand & Sons.
2. Bhatia. RC (2020). Entrepreneurship: Business and Management. S. Chand & Sons.
3. Nitin Zaware, Shilpa R Kankonkar and Yogesh S. Daudkhane (2019), Entrepreneurship Development. Thakur Publications Pvt. Ltd.

WEB REFERENCES:

1. https://openpress.usask.ca/entrepreneurshipandinnovationtoolkit/chapter/chapter-1-introduction- to-entrepreneurship/
2. https://articles.bplans.com/10-great-websites-for-entrepreneurs/
3. https://www.entrepreneur.com/article/272185

24DVAC51 **NEXT GENERATION SEQUENCING**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVES:

The Objective of the course provides a comprehensive understanding of NGS platforms and their biological applications. Understand the experimental considerations for different sequencing approaches, including whole-genome sequencing, targeted sequencing, and pooled DNA sequencing. Understand the biological theories and experimental designs for RNA-seq experiments.

UNIT I INTRODUCTION **06**

NGS - Platform overview - Biological applications - Basic concepts - Recent scientific breakthroughs using NGS technology – Data processing - Analysis workflow - Sequence quality evaluation - Alignment theories – Data formats - Data visualization - DNA sequencing - genetic variations - NGS and genetics of complex disease (etiology)

UNIT II DNA SEQUENCING **06**

Experimental considerations - Whole genome sequencing - Target sequencing - Pool sequencing - Sequencing mappability - Refined alignment - Base quality recalibration - Variants identification for Diploid genome, Pooled DNA sequencing, prioritizing genetic variants - non-synonymous variants (SIFT, PolyPhen) – Synonymous variants - Regulatory variants - Statistical methods on rare variants. Next generation sequencing technologies (Illumina, Ion Torrent / Ion Proton, SOLID and Pac Bio) Short read assembly, alignment and applications – denovo Sequencing, resequencing, gene expression.

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UNIT III RNA SEQUENCING **06**

Biological theories on RNA-seq experiments - Experimental considerations - Published examples – Major scientific advance using RNA-seq – Alignment - Gene expression analysis - Differential expression analysis -Alternative splicing - Transcript variation - Allele-specific expression - RNA editing – smRNA.

UNIT IV CHIP – SEQ **06**

Biological theories on ChIP-seq analysis - Published studies - Experimental considerations - DNA fragment evaluation - Peak identification - Two condition comparison - Saturation analysis - Motif finding and related theories -DNA methylation - Experimental considerations - Statistical considerations - Bioinformatics tools – Histone modification - Experimental approaches - Statistical considerations - Hidden Markov model annotating histone

UNIT V ANALYSIS 06

Using RNA-seq Data to Detect Differentially Expressed Genes - Differential Expression Analysis of Complex RNA-seq - small RNA sequencing. Epigenetics Next generation sequencing applications in Agri-Biotech, health care, metagenomics, GWAS and basic sciences.

Total Hours-30 Hours

COURSE OUTCOMES:

- CO-1: To learn about the workflow and Data processing in NGS.
- CO-2: To learn the about different Sequencing Techniques
- CO-3: To acquire the knowledge about RNA sequencing.
- CO-4: To learn about CHIP Sequencing.
- CO-5: To learn about different RNA Sequence Analysis.
- CO-6: To Understand quality assessment metrics and tools used in NGS data validation and error correction.
- CO-7: TO Apply bioinformatics tools for genome alignment, variant calling, and visualization of NGS datasets.
-

TEXT / REFERENCE BOOKS

1. Xinkun Wang (2024), *Next-Generation Sequencing Data Analysis*, 2nd Edition, CRC Press, Boca Raton, FL, USA.

2. Hirak Ranjan Dash, Kelly M. Elkins, and Noora Rashid Al-Snan (Eds.) (2024), *Next Generation Sequencing (NGS) Technology in DNA Analysis*, Academic Press, Cambridge, MA, USA.

WEB RESOURCE LINK

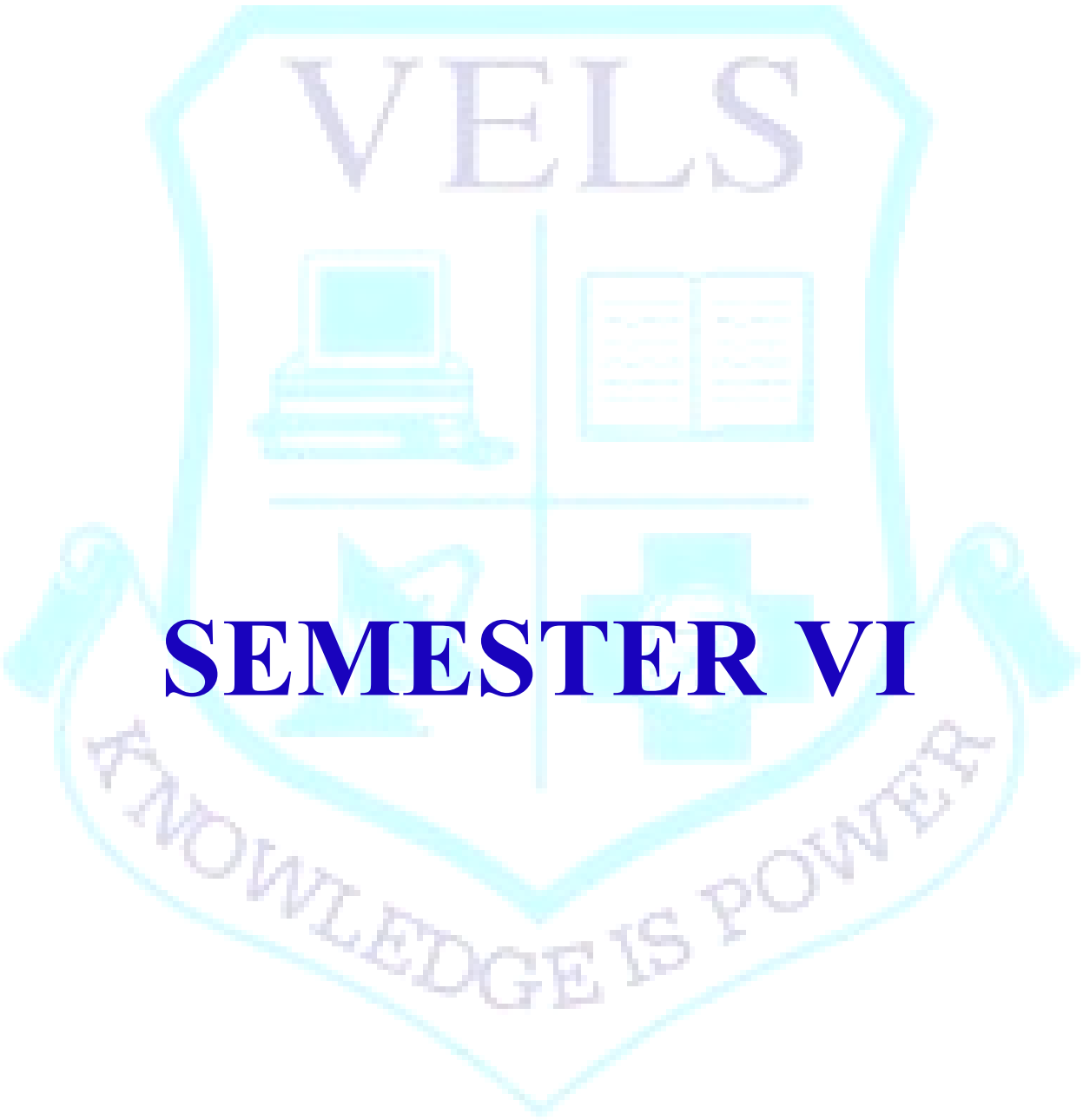
1. *https://sapac.illumina.com/science/technology/next-generation-sequencing.html*

24IBIA51 **INTERNSHIP II**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVE:

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



SEMESTER VI

24CBIA61 R PROGRAMMING LANGUAGE AND BIG DATA ANALYTICS

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: This course will enable the students to understand the basics in R programming in terms of constructs, control statements, string functions. To understand the use of R for Big Data analytics. To able to appreciate and apply the R programming from a statistical perspective

UNIT I INTRODUCTION TO R 12

R Data Structures – Help functions in R- Lists and Arrays– Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector - Basic R Syntax and Debugging

UNIT II DATA TYPES AND VARIABLES 12

R-Data Types: Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with R – Variables - Variable Assignment -R Programming - Data Type of a Variable- Finding Variables- Deleting Variables.

UNIT III DECISION MAKING AND LOOP CONTROL STRUCTURE 12

R-If Statement: If...Else Statement -The if else if .else Statement- Switch Statement- Repeat Loop- While Loop – For Loop - Loop Control Statements – Break Statement – Next Statement- Apply, Lapply, and Sapply Functions for Iteration.

UNIT IV FUNCTION AND STRINGS 12

R-Function: Function Definition -Function Components-Built-in Function-User-defined Function-Calling a Function-Lazy Evaluation of Function- R – Strings -Rules Applied in String Construction-String Manipulation String – Graphics – Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots-

UNIT V VECTORS 12

R-Vectors: Vector Creation- Accessing Vector Elements- Vector Manipulation - Vector Arithmetic - Vector Element Recycling- Vector Element Sorting- Lists in R: Creating, Accessing, and Modifying Lists

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: To understand the basics in R programming in terms of constructs, control statements, string functions.
- CO-2: To understand the use of R for Big Data analytics
- CO-3: To learn to apply R programming for Text processing
- CO-4: Able to appreciate and apply the R programming from a statistical perspective. CO-5: To write the program using R-Vector elements.
- CO-6: To develop and visualize data using R's graphical capabilities, including ggplot2 and three-dimensional plots
- CO-7: To implement and optimize functions in R for efficient data processing and manipulation.

TEXT BOOKS:

1. Norman Matloff. "The Art of R Programming"-2021
2. Zumel & John Mount. Practical Data Science with R- Nina.2014.

REFERENCE BOOKS:

1. Marek Gagolewski, Deep R Programming, 2022
2. Trevor Hastie and Rob Tibshirani., An Introduction to Statistical Learning with Applications in R.2018
3. Mark P.J.van der Loo & Edwin de Jonge. Learning RStudio for R Statistical Computing.2017
4. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics.2020

WEB RESOURCE LINKS:

1. https://link.springer.com/search?query=R+Programming+Big+Data+Analytics

24CBIA62 **DATA SCIENCE IN BIOINFORMATICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES:

This course will enable the students to be able to apply data science principles and techniques to solve complex problems in bioinformatics, utilizing statistical methods and machine learning algorithms. They will gain proficiency in handling and analyzing large-scale biological data, interpreting genomic and proteomic datasets, and developing computational models for biological systems. Additionally, students will be prepared to contribute to advancements in bioinformatics research and applications in biotechnology, medicine, and genetics.

UNIT I INTRODUCTION AND BASIC DATA SCIENCE 12

Introduction to R, R studio, Bioconductor, open-source software and Terminal. Basics of R, including install and configure software necessary for a statistical programming environment. Data aggregation and pivoting examples. Joining tables. Loading in data, data frames, Data types, Machine learning libraries: caret and mlr3.

UNIT II DESCRIPTIVE STATISTICS 12

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

UNIT III SUPERVISED STATISTICAL TESTS 12

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

UNIT IV UN-SUPERVISED STATISTICAL TESTS, MULTIPLE TESTING 12

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

UNIT V APPLIED DATA SCIENCE AND BIOINFORMATICS 12

Enrichment analysis (EA): Hypergeometric, Binomial, Chi-squared, Fisher's exact test. Statistical normalization of genes. Filtering techniques Generate boxplot of normalized and non- normalized data. Gene Ontology (GO) and Pathway enrichment bar plots. Artificial Intelligence in Genomics: Deep learning models- CNNs/transformers.

Total: 60 Hours

COURSE OUTCOMES:

- **C**O-1: Analyze and interpret large-scale biological datasets using data science tools and techniques.
- CO-2: Apply machine learning algorithms to solve bioinformatics problems.
- CO-3: Develop and validate computational models for biological systems.
- CO-4: Utilize statistical methods to extract meaningful insights from genomic and proteomic data.
- CO-5: Integrate bioinformatics knowledge into practical applications in biotechnology, medicine, and genetics.
- CO-6: Implement network biology approaches to understand molecular interactions and regulatory mechanisms.
- CO-7: Utilize structural bioinformatics tools to predict and analyze macromolecular structures for drug discovery and therapeutic applications.

TEXT BOOKS:

1. Jill L. Mesirov, Martin Morgan, Data Science for Genomics,2023, 2nd edition.
2. Robert Gentleman, Vincent Carey, Wolfgang Huber, Rafael Irizarry, Sandrine Dudoit, Bioinformatics and Computational Biology Solutions Using R and Bioconductor,2023, 3rd edition.

REFERENCE BOOKS:

1. Vince Buffalo, Bioinformatics Data Skills: Reproducible and Robust Research with Open-Source Tools, 2021, 2nd edition.
2. Zhongming Zhao, Data Science for Bioinformatics, 2020, 1st edition.

WEB RESOURCE LINKS:

1. https://www.bioconductor.org/
2. https://www.ebi.ac.uk/training/online/
3. https://www.ncbi.nlm.nih.gov/books/

L	T	P	O	C
4	0	0	2	4

24CBIA63 ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS IN BIOINFORMATICS

COURSE OBJECTIVE: To understand the various computational techniques with Artificial Intelligence, analyze biological data with the use of sequence information and also steps involved in Evolutionary analysis. Also helps to start error free sequence analysis investigation successfully.

UNIT I OUTLINE OF BIOINFORMATICS AND AI 12

Artificial Intelligence (AI) Introduction: Definition, Challenges and Applications. Role of AI in bioinformatics. Dynamic Programming: Top-down & Bottom-up approaches, Subclasses. Practical applications of Dynamic Programming algorithms in bioinformatics field. Clustering algorithms – Classification models – Regression models – types of regression models. Classification vs Regression

UNIT II WIDE-RANGING OF SEQUENCE ALIGNMENT 12

Introduction and Applications of Bioinformatics. Classification of biological databases, biological data formats. Introduction to single letter code of amino acids, Symbols used in nucleotides. Data retrieval from Entrez and SRS. Outline and Uses of sequence alignment. Similar sequence search using FASTA and BLAST programs in the database. Pairwise sequence alignment and Multiple sequence alignment. Local and Global alignment (Smith- Waterman and Needleman-Wunsch algorithm). Substitution matrices, Scoring matrices - PAM, BLOSUM and Dot plot. Statistics of alignment score and evaluation.

UNIT III EVOLUTIONARY / PHYLOGENETIC ANALYSIS 12

Overview of Tree analysis. Cladistics, Phenetics and Distances. Various tree types. Overview of Bootstrapping. Tools – Clustal Omega, PHYLIP and Mega. Problems and errors in phylogenetic reconstruction. Overview of AI in Phylogenetic analysis.

UNIT IV GENOME EXPLORATION & PROTEIN ASSESSMENT 12

Gene finding methods. Gene prediction: Analysis and prediction of regulatory regions. Fragment assembly. Genome sequence assembly, Restriction Mapping and Repeat Sequence finder. Primary sequence information. Secondary structure prediction of RNA and Protein. ProtParam, GOR, HNN & Sopma.

UNIT V- ARTIFICIAL INTELLIGENCE (AI) 12

Practice and implications of AI in Healthcare industry. Algorithms for Bioinformatics prediction: HMM and Neural Network. Case study: AI in computational sequence analysis. Gene Prediction & Annotation: DeepGene, FATHMM, Variant Calling & Mutation Analysis: DeepVariant, CRISPR Off-Target Prediction, Protein Structure Prediction: AlphaFold, Protein-Protein Interaction (PPI) Networks, Pathway Analysis & Network Modeling, Disease Diagnosis & Biomarker Discovery, Personalized Medicine.

TOTAL: 60 HOURS

COURSE OUTCOMES:

- CO-1: To do the sequence analysis and phylogenetic prediction with their own knowledge
- CO-2: Also capable to search the protein/gene sequence and structural information from the cany biological databases
- CO-3: Helps to ensure the comparative sequence analysis without any error
- CO-4: To analyze and interpret the biological data through Artificial Intelligence.
- CO-5: Evaluate and Interpret AI-based Bioinformatics Research
- CO-6: Enabling the analysis of vast biological datasets, predicting protein structures, and assisting in drug discovery.
- CO-7: To evaluate for potential and rigorous biological validity, interpretability, and real-world impact.

TEXT BOOKS:

1. Loveleen Gaur, Arun Solanki, Samuel Fosso Wamba, Noor Zaman Jhanjhi., Advanced AI Techniques and Applications in Bioinformatics, CRC Press, 2022
2. S.C. Rastogi et al. Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) Kindle Edition.2014
3. Stuart Russel and Peter Norvig, “Artificial Intelligence- A Modern Approach”, Prentice Hall,2015.

REFERENCE BOOKS:

1. Andreas D. Baxevanis and B.F. Francis Ouellette. Bioinformatics: A Practical Guide to the

analysis of Genes and Proteins. ISBN: 978-0-471-47878-2.
2. George F Luger, “Artificial Intelligence”, Pearson Education, 4th Edition, 2021.

***WEB RESOURCE LINKS*:**

1. Artificial Intelligence Search Methods for Problem Solving by Prof. Deepak Khemani | IIT Madras| SWAYAM
2. Fundamentals of Artificial Intelligence by Prof. Shyamanta M. Hazarika | IIT Guwahati| SWAYAM

VELS
KNOWLEDGE IS POWER

24CBIA64 **MICROBIAL GENOMICS AND METAGENOMICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: To understand in-depth understanding of microbial genomics and metagenomics, focusing on sequencing technologies, genome annotation, comparative genomics, and the analysis of complex microbial communities. Students will explore the applications of genomics in medicine, Biotechnology, and environmental science.

UNIT I INTRODUCTION TO MICROBIAL GENOMICS **12**

History and Importance of Microbial Genomics, Overview of Prokaryotic and Eukaryotic Microbial Genomes Genomic Organization and Gene Structure. Functional Genomics Approaches, Bioinformatics in Microbial Genomics, Applications of Microbial Genomics, Machine learning models to predict gene function.

UNIT II DNA SEQUENCING TECHNOLOGIES **12**

Fundamentals of DNA Sequencing, Sanger Sequencing, Next-Generation Sequencing (NGS): Illumina, PacBio, Oxford Nanopore Whole-Genome Sequencing (WGS) and its applications. Applications of WGS in Microbial Genomics, Genome Assembly Techniques, Genome Annotation, Data Analysis and Interpretation, Ethical and Legal Aspects -Data sharing policies (e.g., GenBank, ENA), Privacy concerns in pathogen genomics, Intellectual property and biosecurity implications, Network analysis for microbial interactions.

UNIT III GENOME ASSEMBLY AND ANNOTATION **12**

Reads Quality Control and Preprocessing, De Novo Assembly vs. Functional Insights and Metabolic Reconstruction, Functional Databases and Ontologies, Comparative Genomics & Genome Visualization, Integration with Multi-Omics Data, Deep learning models (CNNs, RNNs) to improve base-calling accuracy in NGS platforms.

UNIT IV COMPARATIVE AND FUNCTIONAL GENOMICS **12**

Pan-Genome and Core Genome Analysis, Horizontal Gene Transfer and Evolution, Pathogenomics and Virulence Factors. Network-based Artificial Intelligence methods to model host-pathogen interactions.

UNIT V METAGENOMIC DATA PROCESSING AND ANALYSIS **12**

Sample Collection, DNA Extraction, and Library Preparation, Bioinformatics Pipelines for Metagenomics (QIIME, MetaPhlAn, MEGAHIT), Taxonomic and Functional Profiling, Human Microbiome and Health Implications, Machine Learning models (Random Forests, SVMs) for predicting community composition and function.

Total 60 Hours

COURSE OUTCOMES:

- 9CO 1: Understand fundamental concepts in microbial genomics and metagenomics.

- CO 2: Describe sequencing technologies and their applications in microbial research.
- CO 3: Analyse and interpret genomic and metagenomic data.
- CO4 : Apply bioinformatics tools for genome assembly, annotation, and comparison.
- CO5: Understand the role of microbiomes in various environments and host systems.
- CO6: Interpret taxonomic and functional profiles of microbial communities.
- CO7: Apply statistical and machine learning methods for data analysis.

TEXT BOOKS:

1. Vineet Kumar, Vinod Kumar Garg, Sunil Kumar, Jayanta Kumar Biswas, Omics for Environmental Engineering and Microbiology Systems, CRC Press, 2023.
2. Quince, C., Walker, A. W., Simpson, J. T., Loman, N. J., & Segata, N. (2017). *Shotgun Metagenomics, From Sampling to Analysis*. Nature Biotechnology.

REFERENCE BOOKS:

1. Pevsner, J. (2015). *Bioinformatics and Functional Genomics*. Wiley-Blackwell.
2. Handelsman, J. (2019). *Metagenomics: Applications and Opportunities*. ASM Press.
3. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2020). *Brock Biology of Microorganisms*. Pearson.

WEB SOURCE:

1. **http:/German Network for Bioinformatics Infrastructure (de.NBI)**: Offers training programs, workshops, and resources related to bioinformatics, including microbial genomics and metagenomics.

24DBIA6- APPLIED CLINICAL PHARMACOKINETICS

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: This course will enable the students to assist in developing their skills to understand and assess clinically relevant drug interactions in a way to finally contribute for minimizing adverse drug interactions (ADRs) in healthcare. To acquire knowledge and practical skills as practitioners in order to improve drug efficacy and safety profiles in clinical practice.

UNIT I Fundamentals of Drug Pharmacokinetics and Interactions **12**

Protein binding of drugs and clinical relevance, Intestinal and hepatic drug metabolism, Mechanisms of drug interactions (enzyme induction/inhibition), Pharmacokinetic and pharmacodynamic interactions, Adverse drug interactions and risk assessment

UNIT II Principles of Clinical Pharmacokinetics **12**

Drug absorption, distribution, metabolism, and elimination - Bioavailability and bioequivalence studies - Half-life, steady-state concentration, and dose adjustments - Therapeutic drug monitoring (TDM) - Effect of renal and hepatic impairment on pharmacokinetics

UNIT III Drug metabolism and transporters **12**

Routes of administration and drug dissolution - Membrane permeability and drug transporters - Drug-Metabolizing Enzymes and Transporters Cytochrome P450 (CYP) enzyme system: Types, function, and clinical significance, Phase I and Phase II metabolism: Oxidation, reduction, hydrolysis, conjugation, Drug transporters, Role of pharmacogenomics in drug response.

UNIT IV Drug Elimination and Clinical Implications **12**

Mechanisms of renal elimination and clearance - First-pass metabolism and bioavailability - Drug metabolism in special populations (neonates, elderly, pregnant women) - Non-linear pharmacokinetics and dose-dependent metabolism - Case studies on altered drug metabolism and adverse effects

UNIT V Advanced Clinical Applications of Pharmacokinetics **12**

Pharmacokinetics in Special Populations: Pediatric and geriatric pharmacokinetics, Drug metabolism and elimination in critically ill patients, Pharmacokinetics in obesity and malnutrition, Clinical Drug Interactions and Risk Management: Enzyme induction/inhibition in clinical practice, Drug-drug, drug-food, and drug-herb interactions, Importance of TDM, Role of artificial intelligence and modeling in dose adjustments, Toxicokinetics and Drug Overdose Management: Drug accumulation and toxicity, Clinical strategies for managing drug overdoses

Total: 60 Hours

COURSE OUTCOMES:

- CO1: Understand fundamental pharmacokinetic principles and their clinical significance.
- CO2: Analyze drug interactions and their impact on drug efficacy and safety.
- CO3: Apply pharmacokinetic models to optimize drug therapy in special populations.
- CO4: Evaluate the role of drug metabolism and transporters in pharmacokinetics.
- CO5: Assess dose adjustments and therapeutic drug monitoring (TDM) in clinical settings.
- CO6: Develop strategies to minimize adverse drug reactions and optimize drug dosing.
- CO7: Utilize emerging technologies, such as artificial intelligence and pharmacokinetic modeling, to improve drug dosing and patient safety.

TEXT BOOKS:

1. Rowland, M., & Tozer, T.N. (2023). Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications (5th Edition). Wolters Kluwer.
2. Shargel, L., & Yu, A.B.C. (2022). Applied Biopharmaceutics & Pharmacokinetics (7th Edition). McGraw-Hill Education.
3. Brunton, L., Hilal-Dandan, R., & Knollmann, B.C. (2023). Goodman & Gilman's: The Pharmacological Basis of Therapeutics (14th Edition). McGraw-Hill Education.

REFERENCES BOOKS:

1. Winter, M.E. (2022). Basic Clinical Pharmacokinetics (6th Edition). Wolters Kluwer.
2. Birkett, D.J. (2020). Pharmacokinetics Made Easy (2nd Edition). McGraw-Hill Education.
3. Benet, L.Z., & Hoener, B. (2021). Pharmacokinetics: Regulatory, Industrial, Academic Perspectives (2nd Edition). Springer.
4. Rang, H.P., Ritter, J.M., Flower, R.J., & Henderson, G. (2020). Rang & Dale's Pharmacology (9th Edition). Elsevier.

WEB RESOURCE LINKS:

1. https://www.pharmgkb.org/

24DBIA6_ **BIOSAFETY, BIOETHICS AND IPR**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE: To study about bioethics, biosafety-regulatory frame work for GMOS in India and international level for transport GMOS and intellectual properties rights.

UNIT I BIOETHICS 09

What are bioethics? - The legal and socio-economic impacts of biotechnology- Ethical considerations in genetic research and cloning-Public education of the process of biotechnology involved in generating new forms of life for informed decision- making – ethical concerns of biotechnology research and innovation.

UNIT II BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS IN INDIA 09

Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003)

UNIT III BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS AT INTERNATIONAL LEVEL 09

Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety-Nagoya Protocol on Access and Benefit Sharing (2010) – COURSE OBJECTIVES and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs

UNIT IV BIOSAFETY-REGULATORY FRAMEWORK FOR TRANSPORT GMOS IN INDIA AND INTERNATIONAL LEVEL 09

Regulation for Import of GM Products under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, 1989). Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- Regulations on genome editing and

CRISPR technologies, status of implementation in India.

UNIT V INTELLECTUAL PROPERTY RIGHTS 09

Intellectual property rights-TRIP- GATT-International conventions patents and methods of application of patents-Legal Implications-Biodiversity and farmer rights – Patents-Traditional Knowledge and Protection of Indigenous Genetic Resources – Patent laws concerning synthetic biology and gene editing.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: Describe the features of ethical concerns of biotechnology research.

CO-2: Explain the role of Recombinant DNA Advisory Committee (RDAC).

CO-3: Understand the characteristics of the Prevention Food Adulteration Act (1955).

CO-4: Explain the facts of Convention of Biological Diversity.

CO-5: Deliver the details of Advanced Information Agreement (AIA) procedure.

CO-6: Analyze the ethical, social, and legal implications of genetic modifications and genome editing technologies.

CO-7: Evaluate the regulatory frameworks governing biosafety and bioethics at national and international levels.

TEXT BOOKS:

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi, 2015.
2. Sasson A, Biotechnologies and Development, UNESCO Publications, 2017.

REFERENCE BOOKS:

1. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi.
2. Regulatory Framework for GMOs in India (2016) Ministry of Environment and Forest, Government of India, New Delhi's
3. Cartagena Protocol on Biosafety (2016) Ministry of Environment and Forest, Government of India, New Delhi.

WEB RESOURCE LINKS:

1. https://www.who.int/ethics/biosafety/en/

24PBIA61

L	T	P	O	C
0	0	2	1	1

R PROGRAMMING LANGUAGE AND BIG DATA ANALYTICS PRACTICAL

The objective of this course is to equip students with practical knowledge and hands-on experience in the R programming language for data analysis, statistical computing, and data visualization. Students will learn to write R scripts, manipulate data, perform statistical tests, and generate insightful graphical representations using R. The course aims to develop foundational programming skills applicable in fields such as bioinformatics, data science, and research analytics.

1.	Basic Arithmetic Operations in R	03
2.	Creating and Manipulating Vectors	03
3.	Data Frame Creation and Manipulation	03
4.	Plotting a Graph in R	03
5.	Writing Functions in R	03
6.	Sequence Manipulation in R	03
7.	Pairwise Sequence Alignment	03
8.	Protein Sequence Analysis	03
9.	RNA Secondary Structure Prediction (GC Content & Stability)	03
10.	Phylogenetic Tree Construction Using R	03

Total: 30 Hours

COURSE OUTCOMES:

- CO1: Understand and apply basic arithmetic operations, vector manipulations, and data frame operations in R.
- CO2: Create and customize various types of plots in R for effective data visualization.
- CO3: Develop and implement user-defined functions in R to streamline data analysis tasks.
- CO4: Perform sequence manipulation, pairwise sequence alignment, and protein sequence analysis using R.
- CO5: Analyze RNA secondary structures and construct phylogenetic trees using R-based bioinformatics tools.

- CO6: Organize and document R scripts for clarity and reuse.
- CO7: Automate data analysis tasks using R functions and loops

TEXT BOOK:

1. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data" by Hadley Wickham, Mine Çetinkaya-Rundel, and Garrett Grolemund (2nd Edition, 2023)

REFERENCE BOOKS:

1.Bioinformatics with R: A Comprehensive Guide by Various Authors (2023)

2.R Bioinformatics Cookbook by Dan MacLean (2nd Edition, 2023)

3.Data Science and Predictive Analytics: Biomedical and Health Applications using R" by Ivo D. Dinov (2nd Edition, 2023)

WEB SOURCE

1.https://www.r-project.org/

2.https://www.rstudio.com/

3.https://www.r-bloggers.com

24RBIA61 **MINI PROJECT**

L	T	P	O	C
0	0	4	1	2

COURSE OBJECTIVES:

1. To apply bioinformatics tools and techniques to analyze biological data.
2. Develop problem-solving skills and enhance understanding of biological processes.
3. Introduce bioinformatics software like BLAST, ClustalW, R, Python (BioPython), or web-based tools (e.g., NCBI, KEGG, UniProt).
4. Emphasize open-source tools for accessibility.
5. Teach students to download, preprocess, and analyze data effectively.
6. Deliverables typically include a detailed report, source code, and visualizations or interpretations of the data analysis.

SEMESTER VII

24CBIA71 **COMPUTER AIDED DRUG DESIGNING**

L	T	P	O	C
3	0	0	2	3

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

UNIT I MOLECULAR MODELING AND MECHANICS 09

Basic Concepts of Molecular Structure: Bond Length, Bond Angle, Torsion Angle, Non- Covalent Interactions and force field parametrisation and transferability – Molecular Structure and Internal Energy – Energy Minimization, Derivative and Non-Derivative Methods, Local and Global Minima.

UNIT II QUANTUM MECHANICS 09

Introduction to Computational Quantum Mechanics: One Electron Atom, Poly Electronic Atoms and Molecules, Hatree Fock Equations, Molecular Properties calculation using Ab initio and Semi Empirical Methods, Density Functional Theory, Moller and Plesset Perturbation Theory.

UNIT III MOLECULAR MODELING AND DOCKING 09

Molecular Modeling in Drug Discovery, Sequence Analysis, Secondary structure prediction, Tertiary Structure prediction- Homology Modeling, Threading and ab-initio methods, Structure validation, Molecular Docking – Introduction, Approaches (Simulation and Shape complementarity approach), Molecular Docking Algorithm, Docking Optimization- Scoring functions, Molecular Docking Application.

UNIT IV PHARMACOPHORE 09

Pharmacophore – Historical Perspective and Features, Viewpoint of Pharmacophore, Pharmacophore modeling- Molecular alignments, handling flexibility, alignment techniques, scoring and optimization, conformational expansion, validation and usage, Applications of pharmacophore model in medicinal chemistry

UNIT V MOLECULAR DYNAMICS 09

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

Total: 45 Hours

COURSE OUTCOMES:

- CO-1: To understand the fundamentals of molecular mechanics and its structure.
- CO-2: To analyze the concept of computational quantum mechanics using energy theory.
- CO-3: To apply the basic principles, models, and theory of molecular docking in drug designing.
- CO-4: To design the model using molecular ligand system and their pharmacophore prediction.
- CO-5: To learn the various methods of dynamic approaches in the *Insilco* docking studies.
- CO-6: Explain the stages of drug discovery and development.
- CO-7: Discuss lead discovery and its identification.

TEXT BOOKS:

1. Andrew R. Leach. Molecular Modelling: Principles and Applications, second edition. Pearson Education EMA, January 2021 ISBN 0-582-38210-6

REFERENCES BOOKS:

1. D. C. Rapaport, The Art of Molecular Dynamics Simulation, 2014, ISBN 0-521- 82568-7

2. M. P. Allen, D. J. Tildesley, Computer simulation of liquids, 1989, Oxford University Press, ISBN 0-19-855645-4.

3. R. J. Sadus, Molecular Simulation of Fluids: Theory, Algorithms and Object- Orientation, 2002, ISBN 0-444-51082-6.

WEB RESOURCE LINKS:

1. https://link.springer.com/search?query=Computer-Aided+Drug+Design.

24CBIA72 **ADVANCED BIOINFORMATICS ALGORITHM**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: To know the biological algorithms versus Computer algorithms, iterative, recursive, fast and slow algorithms. The course covers fundamental algorithms for sequence alignment, gene prediction, and structural bioinformatics, emphasizing both theoretical concepts and practical applications. Students will develop the skills to implement and apply these algorithms to solve complex biological problems, preparing them for advanced research and professional work in bioinformatics and computational biology.

UNIT I INTRODUCTION 12

Algorithms – Definition and Example – Biological algorithms versus Computer algorithms – Types of algorithms – iterative, recursive, fast and slow algorithms – Running time of an algorithm – Big O notation

UNIT II TECHNIQUES 12

Algorithm Design techniques – Brute force, branch and bound, greedy algorithms, Dynamic programming, divide and conquer, randomized algorithm – NP complete problems.

UNIT III ALGORITHMS FOR ALIGNMENT 12

Dynamic Programming Algorithms – Sequence Alignment –Global alignment using Needleman-Wunsch algorithm – Local alignment using Smith-Waterman algorithm – Gap penalties – Fixed and Affine Gap penalties

UNIT IV SIMILARITY SEARCH ALGORITHMS 12

Heuristic Similarity Search algorithms – Approximate Pattern Matching - FASTA algorithm – BLAST algorithm – Comparing a sequence against a database.

UNIT V GRAPH ALGORITHMS 12

Graph Algorithms – Graphs and Genetics – DNA sequencing – Shortest superstring problem – DNA arrays as an Alternative Sequencing Technique

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: Explain the features of an algorithm, what makes a good algorithm and classes of algorithm. CO-2: Implement the algorithms in software applications.
- CO-3: Give an overview of searching algorithms - both exhaustive and heuristic.
- CO-4: Describe the aspects of Dynamic programming algorithms - such as Smith-Waterman
- local sequence alignment.
- CO-5: Explain the facts about the algorithms for sequence alignment.
- CO-6: Implement algorithms for protein folding simulations and stability predictions.
- CO-7: Utilize tools like WEKA for developing predictive models based on biological data.
-

TEXT BOOKS:

1. N.C. Jones and P.A. Pevzner, An Introduction to Bioinformatics Algorithms, Ane Books, New Delhi, 2015.

REFERENCE BOOKS:

1. R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis, Cambridge Univ. Press, Cambridge, UK 2020

WEB RESOURCE LINK:

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

24CBIA73 **STRUCTURAL BIOINFORMATICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: This course will enable the students to explore primary and derived databases in the field of computational structural biology and to visualize macromolecular structures using various visualization tools. Finally acquire skills to use different approaches for prediction of protein structure.

UNIT I STRUCTURAL BIOLOGY 12

Nucleic acid structures, RNA folding, RNA loops, various ribose ring conformations, Ribose-ring puckering, Protein Structure, Protein-protein interactions, Protein ligand interactions, DNA- binding proteins, RNA-binding proteins. Ramachandran plot, 3-dimensional structures of membrane proteins, importance of 310 helix and loops, biophysical aspects of proteins and nucleic acids.

UNIT II STRUCTURAL DATABASES 12

Structural databases: - Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB). Secondary structure, three-dimensional structure prediction, protein folding and functional sites, protein folding classes. Predicting transmembrane helices, Primary structure analysis and prediction, Secondary structure analysis and prediction, motifs, profiles, patterns and fingerprints search. Methods of sequence-based protein prediction.

UNIT III PROTEIN STRUCTURE PREDICTION 12

Protein Structure Prediction: - Homology modeling, prediction of protein structure from sequences, functional sites, Protein folding problem, protein folding classes, protein identification and characterization: - AACompIdent, TagIdent, PepIdent and MultiIdent, PROSEARCH, PepSea, PepMAPPER, FindPept,

UNIT IV MOLECULAR MODELING 12

Molecular modeling: -Introduction, force field, quantum chemistry, Schrödinger equation, potential energy functions, energy minimization, local and global minima, saddle point, grid search, various approximations; LCAO, HF, semi-empirical calculations; single point calculations, full-geometry optimization methods, ZDO, MNDO, CNDO, NDDO, AM1, PM3, RM1. conformational search, Z-matrix, docking, molecular modelling packages.

UNIT V STRUCTURAL FEATURES OF RNA 12

Molecular mechanics: -Definition, balls and springs, force fields, bond-stretching, bond- bending, dihedral motions, out of plane angle potential, non-bonded interaction, coulomb interactions, conformational search, united atoms and cut-offs. Derivative methods: - First- order methods; Steepest descent, conjugate gradient, Second order methods; Newton-Raphson method.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the structural organization, structural properties and various techniques employed in the structure determination of biological macromolecules – DNA, Protein and Carbohydrates

CO-2: To explain about primary and secondary structures of proteins

CO-3: To describe criteria for assessing and refining a predicted protein structure.

CO-4: To learn about various methods used in energy minimization.

CO-5: To have been introduced to a variety of drug classes and some pharmacological properties.
CO-6: Describe the basic structural motifs in proteins, nucleic acids, and other biomolecules.
CO-7: Communicate findings through reports and presentations.

TEXT BOOKS:

1. Webster David (Editor). Protein Structure Prediction: Methods and Protocols (Methods in Molecular Biology) Volume 143. Publisher: New Jersey Humana Press. 2017. ISBN: 0896036375.

REFERENCE BOOKS:

1. D. C. Rapaport 1. Cesareni Giovanni, Gimona Mario, Sudol Marius, Yaffe Michael (Editors). Modular Protein Domains. Publisher: Weinheim Wiley-VCH. 2005. ISBN: 352730813X.
2. Höltje Hans-Dieter, Sippl Wolfgang, Rognan Didier, FolkersGerd. MolecularModeling: Basic Principles and Applications. Publisher: New York, Wiley-VCH. 2003.ISBN: 3527305890.

WEB RESOURCE LINKS:

1. https://www.bioinformatics.org/

24DBIA7_ **ENZYME ENGINEERING AND TECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: To know Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, presteady state kinetics and to understand Kinetics of multi-substrate reactions, Allosteric enzymes.

UNIT I INTRODUCTION TO ENZYMES 12

Classification of enzymes, specificity of enzyme action – monomeric and oligomeric enzymes, - Factors modifying enzyme activity, biotechnological applications of enzymes and applications of enzymes in various industries. Applications in medicine, synthetic biology, and computational modeling, Enzymes in Biofuels and Food & Agriculture.

UNIT II CHEMICAL NATURE OF ENZYME CATALYSTS 12

Structural Components of Enzymes – Structure, apoenzymes, prosthetic group, cofactors, Mechanisms of reactions catalyzed by enzymes – Metal activated enzymes – metalloenzymes – involvement of co enzymes.

UNIT III FREE AND IMMOBILISED ENZYME KINETICS 12

Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, presteady state kinetics, Kinetics of multi-substrate reactions, Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model, Temperature and pH effects on enzyme activity. Methods of immobilization of enzymes, Kinetics of immobilized enzymes – Effects of external mass transfer and intra – particle diffusion.

UNIT IV EXTRACTION AND PURIFICATION OF ENZYMES 12

Methods of production of enzymes, Extraction of Enzymes –soluble enzymes – membrane bound enzymes – Nature of extraction medium – purification of enzyme – criteria of purity – Determination of molecular weight of enzymes. Extraction Methods: Ultrasonication, High-pressure homogenization, Enzymatic lysis and Bead milling. Extraction Methods: Ultrasonication, High-pressure homogenization, Enzymatic lysis and Bead milling. Purification Techniques: Precipitation Methods, Chromatographic Techniques and Membrane-Based Purification.

UNIT V INSTRUMENTAL TECHNIQUES IN ENZYMATIC ANALYSIS 12

Principles – Manometry – Spectrophotometry – Spectro fluorimetry – Electrochemical methods – Enthalpimetry – Radio chemical methods – Automation in enzymatic analysis. Chromatographic Techniques: High-Performance Liquid Chromatography, Gas Chromatography and Thin-Layer Chromatography.

Total: 60 Hours

COURSE OUTCOMES:

- CO-1: Know the aspects of monomeric and oligomeric enzymes.
- CO-2: Use the biotechnological applications of enzymes and applications of enzymes in various industries.
- CO-3: Learn the mechanisms of reactions catalysed by enzymes
- CO-4: Describe the facts about metalloenzymes.
- CO-5: Explain the kinetics of immobilized enzymes.
- CO-6: Describe the principles and applications of ultrasonication, high-pressure homogenization, enzymatic lysis, and bead milling in enzyme extraction.
- CO-7: Interpret chromatographic data to assess enzyme purity and activity.

TEXT BOOKS:

1. Trevor Palmer and Philip Bonner," *Enzymes*", 2nd edition, East West Press, New Delhi, 2018.
2. Robert A. Copeland, *"Enzymes-A Practical Introduction* to Structure, Mechanism and Data Analysis", 2nd edition, John Wiley and Sons, 2014.

REFERENCE BOOKS:

1. Harwey W. Blanch and Douglas S. Clark. "*Biochemical Engineering", CRC* Press,2017

WEB RESOURCE LINKS:

1. https://learncheme.com/

24DBIA7_ **COMPUTATIONAL INTELLIGENCE**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: The subject provides an insight into the concepts of Computational Intelligence helps to identify and understand the basics of AI and its search. Meanwhile, to study about the Fuzzy logic systems and understand and apply the concepts of Neural Network and its functions. IN addition, understand the concepts of Artificial Neural Network and study about the Genetic Algorithm.

UNIT I ARTIFICIAL INTELLIGENCE 12

Problem formulation – AI Applications – Problems – State Space and Search – Production Systems – Breadth First and Depth First – Travelling Salesman Problem – Heuristic search techniques: Generate and Test – Types of Hill Climbing.

UNIT II FUZZY LOGIC SYSTEMS 12

Notion of fuzziness – Operations on fuzzy sets – T-norms and other aggregation operators – Basics of Approximate Reasoning – Compositional Rule of Inference – Fuzzy Rule Based Systems – Schemes of Fuzzification – Inferencing – Defuzzification – Fuzzy Clustering – fuzzy rule-based classifier.

UNIT III NEURAL NETWORKS 12

Learning rules and various activation functions, Single layer Perception Back Propagation networks, Architecture of Backpropagation (BP) Networks, Back propagation Learning -Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map.

UNIT IV ARTIFICIAL NEURAL NETWORKS 12

Fundamental Concepts – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts, Neuron – Linear Separability – Hebb Network.

UNIT V GENETIC ALGORITHM 12

Introduction – Biological, Background – Genetic Algorithm Vs Traditional, Algorithm – Basic Terminologies in Genetic, Algorithm – Simple GA – General Genetic, Algorithm – Operators in Genetic Algorithm.

Total: 60 Hours

COURSE OUTCOMES:

CO1: TO Describe the fundamentals of artificial intelligence concepts and searching techniques.
CO2: To Develop the fuzzy logic sets and membership function and defuzzification techniques.
CO3: TO Understand the concepts of Neural Network and analyze.
CO4: To Understand the artificial neural networks and its applications.
CO5: To Understand the concept of Genetic Algorithm and Analyze the optimization problems using GAs.
CO6: Correlate structural information with biological function and mechanisms.
CO7: Predict the effects of mutations on protein structure and function.

TEXT BOOK:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, 2020

REFERENCE BOOKS:

1. F. Martin, Mc neill, and Ellen Thro, "Fuzzy Logic: A Practical approach", AP Professional, 2000. Chin Teng Lin, C. S. George
2. Lee," Neuro-Fuzzy Systems", PHI Chin Teng Lin, C. S. George Lee," Neuro-Fuzzy Systems", PHI."

WEB RESOURCE LINKS:

1. https://www.bioinformatics.org/

24PBIA71 COMPUTER AIDED DRUG DESIGNING PRACTICAL X

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVE:

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

1. Biological sequence retrieval using NCBI and Uniprot to analysis blast p/n. 03
2. Physical and chemical properties of protein using Protparam. 03
3. Predict the secondary structure of given sequence using Sopma. 03
4. Homology modeling using Swiss model and model validation using saves. 03
5. Active site prediction for targeted protein and retrieve drug molecule using PubChem or Drug bank. 03
6. Protein-protein network prediction by string. 03
7. Protein ligand interaction prediction by Patch dock or Argus lab 03
8. Visualization and validation using pymol 03
9. Visualization and validation using discovery studio software 03
10. Functional prediction hypothetical protein using cdd and pfam. 03

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To design the small molecules using softwares.

CO-2: Able to model the protein structure with the help of modelling softwares.

CO-3: To analyse and validate the structure of protein.

CO-4: To demonstrate the concepts of molecular docking and dynamics using softwares.

CO-5: To perform and handled large sets of compounds using screening method.

CO-6: Discuss the relationship between biomolecular structure and function.

CO-7: Access and navigate structural databases such as PDB, UniProt, and EMDB.

TEXT BOOKS:

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

REFERENCES BOOKS:

1. D. C. Rapaport, The Art of Molecular Dynamics Simulation, 2014, ISBN 0-521-82568-7
2. M. P. Allen, D. J. Tildesley, Computer simulation of liquids, OxfordUniversity Press, ISBN 0-19-855645-4.
3. R. J. Sadus, Molecular Simulation of Fluids: Theory, Algorithms and Object-Orientation, 2002, ISBN 0-444-51082-6
4. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley.

WEB RESOURCE LINKS:

1. https://link.springer.com/search?query=Computer-Aided+Drug+Design

24RBIA71 **RESEARCH PROJECT I**

L	T	P	O	C
0	0	12	4	6

COURSE OBJECTIVE

After completion of this course student would be able to

1. Carrying out literature survey
2. Formulate research problems
3. Framing the objectives for the research problem.
4. Choosing correct methodology for particular problem
5. Obtaining the results for the mentioned objectives
6. Discussing the results for the mentioned objectives
7. Prepare the project report.
8. Understand the importance of adding references to the project report

SEMESTER VIII

24CBIA81 **DATABASE MANAGEMENT SYSTEM**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: To study about relational databases, database design, structured query language, transaction processing and concurrency control, trends in database technology.

UNIT I INTRODUCTION TO DBMS 09

File Systems Organization – Purpose of Database System- Purpose of Database System – Views of data – Data Models – Database Languages –Database System Architecture – Database users and Administrator – Entity– Relationship model (E-R model) – E-R Diagrams -- Introduction to relational databases.

UNIT II DATABASE DESIGN 09

Design Issues in choosing attributes or entity set or relationship set- Constraints- Super Key- Candidate Keys- Primary Key- ER Diagram Notations- Goals of ER Diagram- Weak Entity Set- ER Diagram Construction- Tabular Representation of Various ER Schema- Views.

UNIT III STRUCTURED QUERY LANGUAGE 09

SQL Standards - Data types - Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL - The Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT- Nested Queries-Aggregate Functions- Null Values.

UNIT IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL 09

Introduction - Properties of Transaction - Serializability - Concurrency Control – Locking Mechanisms - Two Phase Locking – Intent Locking – Deadlock - Serializability – Recovery Isolation Levels – SQL Facilities for Concurrency.

UNIT V TRENDS IN DATABASE TECHNOLOGY 09

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

multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

Total: 45Hours

COURSE OUTCOMES:

CO-1: Provide the details about the advantage of DBMS approach.

CO-2: Explain the Database design using ER model.

CO-3: Understand the facts about Relational Database and their integrity constrains.

CO-4: Describe the mechanisms for concurrency control.

CO-5: Comment on the details about Data Warehouse and Data Marts.

CO-6: Retrieve and interpret structural data for proteins, nucleic acids, and complexes.

CO-7: Apply tools like PDBe-KB and InterPro for structural analysis and classification.

TEXT BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 6th Edition, Pearson / Addision wesley, 2021.
2. Raghu Ramakrishnan, "Database Management Systems", 3rd Edition, McGrawHill, 2023.

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Kroth, S. Sudarshan, Database System Concepts, 6th Edition, McGraw- Hill Higher Education, USA, 2015.
2. S.K. Singh, "Database Systems Concepts, Design and Applications", 1st Edition, Pearson Education, 2016.

WEB RESOURCE LINKS:

1. https://sircrrengg.ac.in/images/CSEMATERIALS/R19_DBMS_MATERIAL.pdf

24CBIA82 **MOLECULAR MODELLING AND SIMULATIONS**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVES: To understand the drug stereochemistry drug design and molecular modeling in drug design.

UNIT I INTRODUCTION TO THE CONCEPTS OF MOLECULAR MODELING 09

Molecular structure and internal energy - Application of molecular graphics – Energy minimization of small molecules – Empirical representation of molecular energies – Use of force fields and the molecular mechanics method –Discussion of global energy minimum.

UNIT II MOLECULAR DYNAMICS AND SIMULATIONS 09

The techniques of molecular dynamics and Monte Carlo Simulation for conformational analysis - ab initio – Density-Functional Theory and semi empirical methods.

UNIT III MACROMOLECULAR MODELING 09

Design of ligands for known macromolecular target sites. Drug-receptor interactions. Classical SAR/QSAR studies and their Implications to the 3-D modeler. 2-D and 3-D database searching - pharmacophore identification and novel drug design.

UNIT IV FINDING DRUG TARGETS 09

Finding new drug targets to treat disease - New targets for anti-cancer drugs - Drugs that rescue mutant p53's.

UNIT V ENZYMES 09

Enzyme background – Theories of enzyme inhibition - Enzyme inhibition as a tool for drug development – Structured-based drug design – structural bioinformatics in drug discovery - Examples.

Total: 45 Hours

COURSE OUTCOMES:

CO-1: Learn the aspects of protein kinase inhibitors in drug discovery

CO-2: Realize the features about structure-based and ligand-based virtual screening.

CO-3: Understand the details on the impact of SAR/QSAR studies to the 3D modeller.

CO-4: Be aware of an outlook on the techniques in drug discovery.

CO-5: View on structural bioinformatics in drug discovery.

CO-6: Discuss the relationship between biomolecular structure and function.

CO-7: Explain the principles of molecular folding, including secondary and tertiary structures.

TEXT BOOKS:

1. Andrew Leach, Molecular Modelling: Principles and Applications 2ndEdn.,Addison Wesley Longman, Essex, England, 2018.
2. Alan Hinchliffe, Modelling Molecular Structures, 2ndEdn., John- Wiley, 2020.
3. Alan Hinchliffe, Molecular Modelling for Beginners, John-Wiley, 2018.

REFERENCE BOOKS:

1. N. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego, 1996
2. D. Frenkel and B. Smith, Understanding Molecular Simulations from Algorithms to Applications, Academic Press, San Diego, California, .

WEB RESOURCE LINKS:

1. https://www.ncbi.nlm.nih.gov/Structure/MMDB/mmdb.shtml
2. www.zyvex.com/nanotech/compChemLinks.html
3. www.zyvex.com/nanotech/compChemLinks.html

24CBIA83 **DATA MINING AND MACHINE LEARNING**

L	T	P	O	C
4	0	0	2	4

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

UNIT I INTRODUCTION 12

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

UNIT II DYNAMIC PROGRAMMING 12

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

UNIT III STRUCTURE PREDICTION 12

Sequence coding- correlations- Prediction: secondary structure, signal peptides and cleavage sites- applications for DNA & RNA nucleotide sequences- Performance evaluation. Clustering Algorithms: Hierarchical clustering and K-means clustering, Association Rule Mining and Dimensionality Reduction.

UNIT IV ALGORITHMS AND ITS APPLICATIONS 12

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

UNIT V PHYLOGENETIC ANALYSIS 12

Models for phylogeny-substitution probabilities-Data likelihood-optimal trees- modeling for array data. Phylogenetic Tree Reconstruction, Viral Evolution and Epidemic Tracking, Metagenomics and Microbial Evolution.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Explain the basic outline of machine learning theories and methods

CO-2: Apply the machine learning to biological sequence analysis, gene expression data analysis

CO-3: Describe the methods which are involved for gene prediction

CO-4: Provide the details about machine learning algorithms and applications

CO-5: Gain the knowledge to develop machine learning methods for proteins, DNA and RNA.

CO-6: Explain the significance of data mining techniques in analyzing large-scale genomic and evolutionary data.

CO-7: Use ML-based algorithms to improve the accuracy and efficiency of phylogenetic tree construction.

TEXT BOOKS:

1. Søren Brunak, Pierre F Baldi, Bioinformatics: The Machine Learning approach, MIT Press, 2021.
2. Steffen Schulze-Kremer, Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter, 2016.

REFERENCES BOOKS:

1. Balas Kausik Natarajan, Machine Learning: A Theoretical Approach, Morgan Kaufmann, 2021.
2. Yi-Ping Phoebe. Chen, Bioinformatics Technologies, Springer, 2015.

WEB RESOURCE LINKS:

1.https://www.edx.org/

24DBIA8_

L	T	P	O	C
4	0	0	2	4

BIOINFORMATICS IN IMMUNOLOGY, MICROBIOLOGY AND NANOTECHNOLOGY

COURSE OBJECTIVES: The subject provides an insight into the concepts of microbiology, immunology and nanotechnology. The understanding of basic concepts and mechanism aids the bioinformaticians in developing the right tools and software for the biological problems.

UNIT I MICROBIOLOGY- AN INTRODUCTION 12

Introduction to Microbiology, History of Microbiology, Morphology of bacteria and Physiology of bacteria, Sterilization and Disinfection, Culture Technique, Culture Media, Culture Methods, Identification of Bacteria, Normal Microbial Flora of the Human Body, Bacteriology of Water, Milk & Air, Laboratory Control of Antimicrobial Therapy, Hospital Infection.

UNIT II DATABASES FOR MICROORGANISMS 12

Saccharomyces Genome Database (SGD), Ensembl genome database - Ensembl bacteria, fungi, Metazoa, plants, protists. Microbial Genome database – Bacteria, Archaea, Eukaryota. MLST (Multi locus sequence Typing) databases, BacDive, ECMDB, Integrated Microbial Genomes (IMG), Streptome DB, SporeWeb

UNIT II IMMUNOLOGY 12

Organs of the immune system: Primary Lymphoid organs - Thymus, Bone Marrow and secondary Lymphoid organs- Lymph nodes, Spleen, MALT, Tonsils. Classification of immune system – innate and adaptive immunity, Immune Cells - T Cells & B Cells, Antigens, Antibodies and their structure – IgM, IgG, IgA, IgD, IgE.

UNIT IV ANTIGENS AND ANTIBODIES 12

AbMiner, AlgPred, Antibodies Online -- Antibodies Database, AntigenDB – Pathogen Antigens Database, BCIpep, CEP, CytoSVM, Epitome, ExactAntigen, FRED, GPX, HBVRegDB, HIV Molecular Immunology Database, HPtaa database, IDR, IEDB, IIDB, IMGT, IMGT/3DstructureDB and IMGT/StructuralQuery, T Cell Receptor and MHC Structural Data, IMGT/GeneInfo--V(D)J Recombination Database, IMGT/PRIMER-DB, INTERFEROME, IPD,

InnateDB, MHC-Peptide Interaction Database version T (MPID-T),MHCBN, MHCP, MHCPred, MODPROPEP, MUGEN mouse, NetMHC-3.0, PEPVAC, PIGS, PREDBALB/c, PRRDB, Pcleavage, Protegen –PROTEctiveantiGEN database, SVMHC, SuperHapten, VBASE2, VIOLIN.

UNIT V NANO INFORMATICS 12

Introduction to Nanoinformatics, Applications of nanoinformatics- Development and Scientific goals, Scientific content and informatics goals, integrating data and knowledge, Tools to support professional practice, Methods and tools to support research, Education and training MI and BI professionals. Five significant areas of research where BMI should influence nanoinformatics – Data, Repositories and Standards, Interoperability, Extension of virtual integrative physiological programs, Translational nanoinformatics, Linking nano information to the electronic health record (EHR).

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Analyze microbial genomes and metagenomes to identify microbial diversity and function.
CO-2: Apply sequence-based classification and identification methods for prokaryotes.
CO-3: Use tools like BLAST and MSA for microbial sequence analysis.
CO-4: Understand the synthesis and characterization of nanomaterials using biological methods.
CO-5: Apply bioinformatics approaches to study the interaction of nanomaterials with biological systems.
CO-6: Evaluate the applications of nanotechnology in drug delivery and biosensing.
CO-7: Interpret computational results to draw meaningful biological conclusions.
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TEXT BOOK:

1. N. Arumugam, Dulsy Fatima, A. Mani, LM. Narayanan, AM. Selvaraj, “Immunology and Microbiology”,
2. V. Maojo, AM. Fritts, Martin-Sanchez, “Nanoinformatics: Developing new computing applications for nanomedicine”.

REFERENCE BOOKS:

1. Dr. PHBS Sharma, “Text Book of Microbiology”, 2015.
2. Mani, AM. Selvaraj, LM. Narayanan, N.Arumugam, “Microbiology”

3. Dulsy Fatima, N. Arumugam, “Immunology”

WEB RESOURCE LINKS:

1. https://www.bioinformatics.org/
2. https://microbiologysociety.org/
3. https://www.nanotech-now.com/#google_vignette

24DBIA8_ **METABOLOMICS AND METABOLIC ENGINEERING**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES: To know importance of metabolic engineering, isotope labelling, bottom up and top-down approaches.

UNIT I INTRODUCTION TO METABOLOMICS 12

Overview of metabolomics- Metabolomics *in Arabidopsis thaliana*- Lipidomics.

UNIT II METABOLOME INFORMATICS 12

Introduction to the ARM Database- The Genome-Based E-CELL Modeling (GEM) System- Large-Scale Simulation of Metabolism-Metabolomics and Medical Sciences

UNIT III INTRODUCTION TO METABOLIC ENGINEERING 12

Importance of metabolic engineering-comprehensive models for cellular reactions-material balances & data consistency- metabolic pathway synthesis.

UNIT IV METABOLIC FLUX ANALYSIS AND ITS APPLICATION 12

Theory-determination of flux by isotope labeling-Metabolic control analysis- (control coefficients and summation theorems, FCC determination)-Grouping of reactions (gFCC, identification of independent pathways).

UNIT V FLUX ANALYSIS OF METABOLIC NETWORKS 12

Bottom up and Top-down approaches- case study-optimization of flux amplification- consistency tests and experiment validation

Total:60 Hours

COURSE OUTCOMES:

CO-1: Give an introduction to the ARM Database.

CO-2: Discuss the aspects of genome-based E-CELL modelling (GEM) system.

CO-3: Write the importance of metabolic engineering.

CO-4: Give an explanation about the determination of flux by isotope labelling.

CO-5: Describe the details about the optimization of flux amplification.

CO-6: Use tools like BLAST and MSA for microbial sequence analysis.

CO-7: Evaluate the applications of nanotechnology in drug delivery and biosensing.

TEXT BOOKS:

1. M. Tomita, T. Nishioka, *Metabolomics- The Frontier of Systems Biology*, Springer Publications, 2023.

2. Gregory N. Stephanopoulos, *Metabolic Engineering- Principles and Methodologies*, Academic press, First Edition, 2015.

REFERENCE BOOKS:

1. S. Cortassa, *An Introduction to Metabolic and Cellular Engineering*, World scientific public company Ltd., 2021.

2. Wolfram Weckwerth, *Metabolomics: Methods and Protocols*, Humana Press, 2017.

WEB RESOURCE LINKS:

1. https://www.sciencedirect.com/topics/medicine-and-dentistry/metabolomics
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4850886/
3. www.cell.com/cell-metabolism/abstract/S1550-4131(16)30503-4

24PBIA81 **DATABASE MANAGEMENT SYSTEM PRACTICAL XI**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES: To practice SQL queries for database management, relational databases, database design, structured query language, transaction processing and concurrency control, trends in database technology.

Structured Query Language

1. **Creating a Bioinformatics Database/Table** **05**

a) Creating a Database

b) Creating a Table

c) Inserting Data into the bioinformatics Database

d) Query the database to retrieve specific information

e) Updating records in the bioinformatics database.

f) Delete records from the bioinformatics database

2. **Table and Record Handling** **05**

a) INSERT statement

b) Using SELECT and INSERT together

c) DELETE, UPDATE, TRUNCATE statements

d) DROP, ALTER statements

3. **Retrieving Data from a Database** **10**

a) The SELECT statement

b) Using the WHERE clause

c) Using Logical Operators in the WHERE clause

d) Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause

e) Using Functions

f) Combining Tables Using JOINS

g) Subqueries

4. **Database Management** **10**

a) Creating Views

b) Creating Column Aliases

c) Creating Database Users

d) Using GRANT and REVOKE

Total: 30 Hours

COURSE OUTCOMES:

CO-1: Students can create, query and maintain SQL databases.

CO-2: Explain the Database design using ER model.

CO-3: Understand the facts about Relational Database and their integrity constrains.

CO-4: Describe the mechanisms for concurrency control.

CO-5: Comment on the details about Data Warehouse and Data Marts.

CO-6: Understand logging, checkpoints, and shadow paging.

CO-7: Apply security measures such as authentication and authorization.

TEXT BOOKS:

1. Raghu Ramakrishnan, 2023, "Database Management Systems", 3rd Edition, McGrawHill.

REFERENCE BOOKS:

2. S.K. Singh, 2016, "Database Systems Concepts, Design and Applications", 1st Edition, Pearson Education.

WEB RESOURCE LINKS:

1. https://sircrrengg.ac.in/images/CSEMATERIALS/R19_DBMS_MATERIAL.pdf

24PBIA82

MOLECULAR MODELLING AND SIMULATIONS PRACTICAL XII

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVES: To understand the drug stereochemistry drug design and molecular modeling in drug design and to understand the proteins enclosed by the genes with respect to structure, function, protein – protein interactions, techniques for separation and analysis, database and applications the prokaryotic and eukaryotic genomes, general methods of genome sequencing techniques, genome analysis and annotations, genome mapping techniques and applications of genomics.

1. Protein Sequence Retrieval and Basic Analysis	03
2. Protein Structure Prediction Using AlphaFold / I-TASSER	03
3. Molecular Visualization Using Chimera	03
4. Energy Minimization Using ModRefiner	03
5. Ligand Preparation and Conversion Using Open Babel	03
6. Active Site Prediction	03
7. Molecular Docking Using AutoDock Vina	03
8. Molecular Dynamics Simulation Setup	03
9. Protein-Ligand Interaction Analysis	03
10. Structural Comparison and Alignment	03

Total: 30 Hours

COURSE OUTCOMES:

CO-1: Retrieve information about the metabolic pathway from KEGG database.

CO-2: Study the conserved domain prediction by CDD

CO-3: Give details about genome databases

CO-4: Describe the tools to design and analyze primers for PCR.

CO-5: Describe the details on the tools involved for genome annotation.

CO-6: Interpret structural features such as binding sites, active sites, and structural domains.

CO-7: Perform structural alignment and comparison to identify evolutionary relationships.

TEXT BOOKS:

1. Pennigton SR and Dunn MJ, 2002, Proteomics, Viva Books Pvt. Ltd, New Delhi.

REFERENCE BOOKS:

1. Richard J. Reece, 2015, Analysis of Genes and Genomes, John Wiley & Sons, Ltd., Publications, UK.

WEB RESOURCE LINKS:

1. https://www.ncbi.nlm.nih.gov/Structure/MMDB/mmdb.shtml
2. www.zyvex.com/nanotech/compChemLinks.html
3. www.zyvex.com/nanotech/compChemLinks.html

24RBIA81 **RESEARCH PROJECT II**

L	T	P	O	C
0	0	12	4	6

COURSE OBJECTIVES:

1. Carrying out literature survey
2. Formulate research problems
3. Framing the objectives for the research problem.
4. Choosing correct methodology for particular problem
5. Obtaining the results for the mentioned objectives
6. Discussing the results for the mentioned objectives
7. Prepare the project report.
8. Understand the importance of adding references to the project report