B Sc BIOTECHNOLOGY

LOCF SYLLABUS 2025

Department of Biotechnology
School of Biological Sciences
St. Joseph's College (Autonomous)
Tiruchirappalli - 620002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) UNDERGRADUATE COURSES

St. Joseph's College (Autonomous), an esteemed institution in the realm of higher education in India, has embarked on a journey to uphold and perpetuate academic excellence. One of the pivotal initiatives in this pursuit is the establishment of five Schools of Excellence commencing from the academic year 2014-15. These schools are strategically designed to confront and surpass the challenges posed by the 21st century.

Each School amalgamates correlated disciplines under a unified umbrella, fostering synergy and coherence. This integrated approach fosters the optimal utilization of both human expertise and infrastructural assets. Moreover, it facilitates academic fluidity and augments employability by nurturing a dynamic environment conducive to learning and innovation. Importantly, while promoting collaboration and interdisciplinary study, the Schools of Excellence also uphold the individual identity, autonomy, and distinctiveness of every department within.

The overarching objectives of these five schools are as follows:

1. Optimal Resource Utilization: Ensuring the efficient use of both human and material resources to foster academic flexibility and attain excellence across disciplines.

2. Horizontal Mobility for Students: Providing students with the freedom to choose courses aligning with their interests and facilitating credit transfers, thereby enhancing their academic mobility and enriching their learning experience.

3. Credit-Transfer Across Disciplines (CTAD): The existing curricular structure, in accordance with regulations from entities such as TANSCHE and other higher educational institutions, facilitates seamless credit transfers across diverse disciplines. This underscores the adaptability and uniqueness of the choice-based credit system.

4. Promotion of Human Excellence: Nurturing excellence in specialized areas through focused attention and resources, thus empowering individuals to excel in their respective fields.

5. Emphasis on Internships and Projects: Encouraging students to engage in internships and projects, serving as stepping stones toward research endeavors, thereby fostering a culture of inquiry and innovation.

6. Addressing Stakeholder Needs: The multi-disciplinary nature of the School System is tailored to meet the requirements of various stakeholders, particularly employers, by equipping students with versatile skills and competencies essential for success in the contemporary professional landscape.

In essence, the Schools of Excellence at St. Joseph's College (Autonomous) epitomize a holistic approach towards education, aiming not only to impart knowledge but also to cultivate critical thinking, creativity, and adaptability – qualities indispensable for thriving in the dynamic global arena of the 21st century.

Credit system

The credit system at St. Joseph's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines.

The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work.

For undergraduate (UG) courses, students are required to accumulate a minimum of 137 credits, as stipulated in the programme pattern table. The total number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

OBE is an educational approach that revolves around clearly defined goals or outcomes for every aspect of the educational system. The primary aim is for each student to successfully achieve these predetermined outcomes by the culmination of their educational journey. Unlike traditional methods, OBE does not prescribe a singular teaching style or assessment format. Instead, classes, activities, and evaluations are structured to support students in attaining the specified outcomes effectively.

In OBE, the emphasis lies on measurable outcomes, allowing educational institutions to establish their own set of objectives tailored to their unique context and priorities. The overarching objective of OBE is to establish a direct link between education and employability, ensuring that students acquire the necessary skills and competencies sought after by employers.

OBE fosters a student-centric approach to teaching and learning, where the delivery of courses and assessments are meticulously planned to align with the predetermined objectives and outcomes. It places significant emphasis on evaluating student performance at various levels to gauge their progress and proficiency in meeting the desired outcomes.

Here are some key aspects of Outcome-Based Education:

Course: A course refers to a theory, practical, or a combination of both that is done within a semester.

Course Outcomes (COs): These are statements that delineate the significant and essential learning outcomes that learners should have achieved and can reliably demonstrate by the conclusion of a course. Typically, three or more course outcomes are specified for each course, depending on its importance.

Programme: This term pertains to the specialization or discipline of a degree programme.

Programme Outcomes (POs): POs are statements that articulate what students are expected to be capable of by the time they graduate. These outcomes are closely aligned with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs outline the specific skills and abilities that students should possess upon graduation within a particular discipline or specialization.

Programme Educational Objectives (PEOs): PEOs encapsulate the expected accomplishments of graduates in their careers, particularly highlighting what they are expected to achieve and perform during the initial years postgraduation.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The Learning Outcomes-Centric Framework (LOCF) places the learning outcomes at the forefront of curriculum design and execution. It underscores the importance of ensuring that these outcomes are clear, measurable, and relevant. LOCF orchestrates teaching methodologies, evaluations, and activities in direct correlation with these outcomes. Furthermore, LOCF adopts a backward design approach, focusing on defining precise and attainable learning objectives. The goal is to create a cohesive framework where every educational element is in harmony with these outcomes.

Assessment practices within LOCF are intricately linked to the established learning objectives. Evaluations are crafted to gauge students' achievement of these outcomes accurately. Emphasis is often placed on employing authentic assessment methods, allowing students to showcase their learning in real-life scenarios. Additionally, LOCF frameworks emphasize flexibility and adaptability, enabling educators to tailor curriculum and instructional approaches to suit the diverse needs of students while ensuring alignment with the defined learning outcomes.

Some Important Terminologies

Core Course (CC): *Core Courses represent obligatory elements within an academic programme, imparting fundamental knowledge within the primary discipline while ensuring consistency and acknowledgment.*

Allied Course (AC): *Allied Courses complement primary disciplines by furnishing supplementary knowledge, enriching students' understanding and skill repertoire within their academic pursuit.*

Skill Enhancement Course (SEC): *Skill Enhancement Courses aim to nurture students' abilities and competencies through practical training, open to students across disciplines but particularly advantageous for those in programme-related fields.*

Value Education (VE): *Value education encompasses the teaching of moral, ethical, and social values to students, aiming to foster their holistic development. It instills virtues such as empathy, integrity, and responsibility, guiding students towards becoming morally upright and socially responsible members of society.*

Ability Enhancement Compulsory Course (AECC): *Ability Enhancement Compulsory Course is designed to enhance students' knowledge and skills; examples include Communicative English and Environmental Science. These courses are obligatory for all disciplines.*

AE-1: Communicative English: This three-credit mandatory course, offered by the Department of English during the first semester of the degree programme, is conducted outside regular class hours.

AE-2: Environmental Science: This one-credit compulsory course, offered during the second semester by the Department of Human Excellence, emphasizes environmental awareness and stewardship.

Allied Optional (AO): *Allied optional course are elective modules that complement the primary disciplines by providing additional knowledge and skills. These courses allow students to explore areas of interest outside their major field of study, broadening their understanding and enhancing their skill set.*

Discipline Specific Elective (DSE): *These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature. Four courses are offered, two courses each in semester V and VI*

Note: To offer one DSE, a minimum of two courses of equal importance/weightage is a must. A department with two sections must offer two courses to the students.

Open Elective (OE): *A course chosen from a different discipline or subject area, typically to gain exposure. Students pursuing specific disciplines must select Open Elective courses from the options available across departments as per the college's course offerings. The breadth of Open Elective (OE) Courses is directly linked to the diversity of disciplines offered by the college. Two OE Courses are available, one in each semester V and VI, and are open to students from other departments.*

Self-Learning (SL): *A two-credit course designed to foster students' ability for independent and self-directed learning. There are* Four Self-Learning Courses:

- *Compulsory MOOC on NPTEL-SWAYAM in Semester I or II*
- 'Artificial Intelligence' *as a Self-Learning Course jointly offered by the Departments of CS, AI, IT and Data Science on JosTEL in Semester III*
- *A Department-Specific Self-Learning Course in Semester IV on JosTEL*
- *A Certificate Course in Semester V: Each department will offer ONE certificate Course (45 – 60 hours) that will be creditised in the curriculum.*

Internship (IS): *Following the fourth semester, students are required to undertake an internship during the summer break. Subsequently, they must submit a comprehensive report detailing their internship experience along with requisite documentation. Additionally, students are expected to participate in a viva-voce examination during the fifth semester. Credits for the internship will be reflected in the mark statement for the fifth semester. One of the Core Courses in Sem IV is offered as internship embedded course which contains content related to industry.*

Experiential Learning (EL): *In the sixth semester, students are required to undertake a one credit Project / Industrial visit / Field visit chosen by the department. This component is intended to foster learning by direct experience and application of acquired knowledge to practical settings.*

Comprehensive Examination (CE): *A detailed syllabus consisting of five units to be chosen from the courses offered over the five semesters which are of immense importance and those portions which could not be accommodated in the regular syllabus.*

Extra Credit Courses: *To support students in acquiring knowledge and skills through online platforms such as Massive Open Online Courses (MOOCs), additional credits are granted upon verification of course completion. These extra credits can be availed across five semesters (2 - 6). In line with UGC guidelines, students are encouraged to enhance their learning by enrolling in MOOCs offered by portals like SWAYAM, NPTEL, and others. Additionally, certificate courses provided by the college also qualify for these extra credits.*

Outreach Programme (OR): *It is a compulsory course to create a sense of social concern among all the students and to inspire them to dedicated service to the needy.*

Course Coding

The following code system (11 alphanumeric characters) is adopted for Under Graduate courses:

25	**UXX**	**0**	**0**	**XX**	**00/X**
Year of Revision	UG Department Code	Semester Number	Part Specification	Course Specific Initials	Running Number/with Choice

Course Specific Initials

GL - Languages (Tamil / Hindi / French / Sanskrit)
GE - General English
CC - Core Theory; CP- Core Practical
AC - Allied Course
AP - Allied Practical
SEC - Skill Enhancement Course
VE - Value Education
WS - Workshop
AE - Ability Enhancement Course
AO - Allied Optional
OP - Allied Optional Practical
ES - Discipline Specific Elective
IS - Internship
SL - Self-Learning
OE - Open Elective
PW - Project and Viva Voce
CE - Comprehensive Examination
EL - Experiential Learning
OR - Outreach Programme

EVALUATION PATTERN (UG)

Continuous Internal Assessment

Sl No	Component	Marks Allotted
1	Mid Semester Test	30
2	End Semester Test	30
3	*Two Components (15 + 20)	35
4	Library Referencing	5
	Total	**100**

Passing minimum: 40 marks

* *The first component is a compulsory online test (JosTEL platform) for 15 marks comprising 7 questions (1 mark) at K1 level and 4 questions (2 marks) at K2 level;* The second component is decided by the course in-charge in accordance with the prescribed K levels.

Question Paper Blueprint for Mid and End Semester Tests

Duration: 2 Hours								**Maximum Marks: 60**
Section		**K levels**						**Marks**
		K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*		7						7 × 1 = 7
B *(compulsory)*			5					5 × 3 = 15
C *(either…or type)*				3				3 × 6 = 18
D *(2 out of 3)*	Mid Sem				1(2)	1*		2 × 10 = 20
	End Sem				1*	1(2)		
							Total	**60**

***** *Compulsory*

Question Paper Blueprint for Semester Examination

Duration: 3 Hours						**Maximum Marks: 100**
Section	**K levels**					**Marks**
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*	10						10 × 1 = 10
B *(compulsory)*		10					10 × 3 = 30
C *(either…or type)*			5				5 × 6 = 30
D *(3 out of 5)*				2(3)	1(2)		3 × 10 = 30
						Total	**100**

***** *Compulsory*

Evaluation Pattern for Part IV and One/Two-credit Courses

Title of the Course	**CIA**	**Semester Examination**	**Final**
• One credit Core Course (Sem 1) • Skill Enhancement Course (NCC and Department Specific)	25 + 25 = 50	50 *(Department)*	100
• Self - Learning Course (Dept Specific) • Comprehensive Examination	25 + 25 = 50	50 *(CoE)*	100
• Value Education • Environmental Studies	50	50 *(CoE)*	100
• Skill Enhancement Course: Soft Skills • Self - Learning Course (Common) • Self - Learning Online Course (NPTEL / SWAYAM) • Certificate Course • Internship	100	-	100
• Project / Industrial Visit / Field Visit	100	-	100

Grading System

The marks obtained in the CIA and semester for each course will be graded as per the scheme provided in Table - 1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$$SGPA\ and\ CGPA = \frac{\sum_{i=1}^{n} C_i Gp_i}{\sum_{i=1}^{n} C_i}$$

$$WAM = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

Where,

Ci - credit earned for the Course i

Gpi - Grade Point obtained for the Course i

Mi - Marks obtained for the Course i

*n - Number of Courses **passed** in that semester*

WAM - Weighted Average Marks

Classification of Final Results

- For each of the first three parts in the UG Programme, there shall be separate classification on the basis of CGPA, as indicated in Table - 2.
- For the purpose of declaring a candidate to have qualified for the Degree of Bachelor of Arts / Science / Commerce / Management as Outstanding / Excellent / Very Good / Good / Above Average / Average, the marks and the corresponding CGPA earned by the candidate in Part III alone will be the criterion, provided the candidate has secured the prescribed passing minimum in all the five Parts of the programme.
- Grade in Part IV and Part V shall be shown separately and it shall not be taken into account for classification.
- A pass in SHEPHERD will continue to be mandatory although the marks will not be counted for the calculation of the CGPA.
- Absence from an examination shall not be considered as an attempt.

Table - 1: Grading of the Courses

Mark Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
40 and above and below 50	5	C
Below 40	0	RA

Table - 2: Grading of the Final Performance

CGPA	Grade	Performance
9.00 and above	O	Outstanding*
8.00 to 8.99	A+	Excellent*
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
4.00 to 4.99	C	Average
Below 4.00	RA	Re-appear

**The Candidates who have passed in the first appearance and within the prescribed duration of the UG programme are eligible. If the Candidates Grade is O/A+ with more than one attempt, the performance is considered "Very Good".*

B Sc Biotechnology					
Programme Structure					
Part	**Semester**	**Specification**	**No. of Courses**	**Hours**	**Credits**
1	1- 4	Languages (Tamil / Hindi / French / Sanskrit)	4	16	12
2	1 - 4	General English	4	20	12
3	1 - 6	Core Course	13	61	48
	1 - 6	Core Practical	7	21	7
	1 & 2	Allied Course	2	8	6
	1 & 2	Allied Practical	2	4	2
	3 & 4	Allied Optional	2	8	6
	3 & 4	Allied Optional Practical	2	4	2
	5 & 6	Discipline Specific Elective	4	16	12
	5	Internship	1	-	1
	6	Project / Industrial Visit / Field Visit	1	-	1
	6	Comprehensive Examination	1	-	2
4	1 - 4	Value Education	4	8	4
	1 & 2	Ability Enhancement Compulsory Course	2	2	3
	2 - 5	Self - Learning	4	-	8
	3 & 4	Skill Enhancement Course	2	4	2
	5 & 6	Open Elective	2	8	4
5	2 - 6	Outreach Programme (SHEPHERD)	-	-	4
	2 - 6	Co-curricular and Extracurricular Activities	-	-	1
	2 - 6	Extra Credit Courses (MOOC) / Certificate Courses	5	-	(15)
		Total	**62**	**180**	**137 (15)**

B Sc BIOTECHNOLOGY PROGRAMME PATTERN									
Course Details							Scheme of Exams		
Sem.	Part	Course Code	Course Type	Title of the Course	Hours	Credits	CIA	SE	Final
1	I	25UTA11GL01	GL	General Tamil - 1	4	3	100	100	100
		25UFR11GL01		Language French - 1					
		25UHI11GL01		Language Hindi - 1					
		25USA11GL01		Language Sanskrit - 1					
	II	25UEN12GE01A	GE	**General English – 1:** Pre-Intermediate Stream	5	3	100	100	100
		25UEN12GE01B		**General English – 1:** Intermediate Stream					
	III	25UBT13CC01	CC Major	**Core Course - 1:** Cell Biology	5	4	100	100	100
		25UBT13CC02		**Core Course - 2:** Microbiology	5	4	100	100	100
		25UBT13CP01		**Core Practical - 1:** Cell Biology and Microbiology	3	1	100	100	100
		25UBT13AC01	AC Minor	**Allied Course - 1:** Chemistry of Biomolecules	4	3	100	100	100
		25UBT13AP01		**Allied Practical - 1:** Chemistry of Biomolecules	2	1	100	100	100
	IV	25UHE14VE01	VE	**Value Education – 1:** Essentials of Humanity*	2	1	50	50	50
		25UEN14AE01	AECC	Communicative English	-	2	100	-	100
				Total	**30**	**22**			
2	I	25UTA21GL02	GL	General Tamil - 2	4	3	100	100	100
		25UFR21GL02		Language French - 2					
		25UHI21GL02		Language Hindi - 2					
		25USA21GL02		Language Sanskrit - 2					
	II	25UEN22GE02A	GE	**General English – 2:** Pre-Intermediate Stream	5	3	100	100	100
		25UEN22GE02B		**General English – 2:** Intermediate Stream					
	III	25UBT23CC03	CC Major	**Core Course - 3:** Molecular Biology	4	4	100	100	100
		25UBT23CC04		**Core Course - 4:** Developmental Biology	4	3	100	100	100
		25UBT23CP02		**Core Practical - 2:** Molecular Biology and Developmental Biology	3	1	100	100	100
		25UBT23AC02	AC Minor	**Allied Course - 2:** Bioanalytical Techniques	4	3	100	100	100
		25UBT23AP02		**Allied Practical - 2:** Bioanalytical Techniques	2	1	100	100	100
	IV	25UHE24AE02	AECC	Environmental Studies*	2	1	50	50	50
		25UHE24VE02	VE	**Value Education – 2:** Fundamentals of Human Rights*	2	1	50	50	50
		25UBT24SL01	SL	Online Courses: NPTEL / SWAYAM	-	2	-	100	100
	-	-	-	Extra Credit Course	-	(3)			
				Total	**30**	**22 (3)**			
3	I	25UTA31GL03	GL	General Tamil - 3	4	3	100	100	100
		25UFR31GL03		Language French - 3					
		25UHI31GL03		Language Hindi - 3					
		25USA31GL03		Language Sanskrit - 3					
	II	25UEN32GE03B	GE	General English – 3: English for Science - 1	5	3	100	100	100
	III	25UBT33CC05	CC Major	**Core Course - 5:** Gene Technology	4	4	100	100	100
		25UBT33CC06		**Core Course - 6:** Immunology	4	3	100	100	100
		25UBT33CP03		**Core Practical - 3:** Gene Technology and Immunology	3	1	100	100	100
		25UBT33AO01A	AO Minor	**Allied Optional - 1:** Enzyme Technology	4	3	100	100	100
		25UBT33AO01B		**Allied Optional - 1:** Drug Discovery and Development					
		25UBT33OP01A		**Allied Optional Practical - 1:** Enzyme Technology	2	1	100	100	100
		25UBT33OP01B		**Allied Optional Practical - 1:** Drug Discovery and Development					
	IV	25UHE34VE03A	VE	**Value Education – 3:** Social Ethics – 1*	2	1	50	50	50
		25UHE34VE03B		**Value Education – 3:** Religious Doctrine – 1*					
		25UNC34SE01 / 25USS34SE01	SEC	**Skill Enhancement Course – 1:** Introduction to NCC / **Skill Enhancement Course – 1:** Soft Skills	2	1	100	-	100
		25UAI34SL02	SL	Artificial Intelligence (Online)	-	2	100	-	100
	-	-	-	Extra Credit Course	-	(3)			
				Total	**30**	**22 (3)**			
4	I	25UTA41GL04B	GL	General Tamil – 4: அறிவியல் தமிழ் (Scientific Tamil)	4	3	100	100	100
		25UFR41GL04		Language French - 4					
		25UHI41GL04		Language Hindi - 4					
		25USA41GL04		Language Sanskrit - 4					

	II	25UEN42GE04B	**GE**	General English – 4: English for Science - 2	5	3	100	100	100
	III	25UBT43CC07	**CC Major**	**Core Course - 7:** Bioprocess Technology	4	3	100	100	100
		25UBT43CC08		**Core Course – 8:** Bioinformatics (Internship Embedded Course)	4	4	100	100	100
		25UBT43CP04		**Core Practical - 4:** Bioprocess Technology	3	1	100	100	100
		25UBT43AO02A	**AO Minor**	**Allied Optional - 2:** Molecular Genetics	4	3	100	100	100
		25UBT43AO02B		**Allied Optional - 2:** Biodiversity and Conservation					
		25UBT43OP02A		**Allied Optional Practical - 2:** Molecular Genetics	2	1	100	100	100
		25UBT43OP02B		**Allied Optional Practical - 2:** Biodiversity and Conservation					
	IV	25UHE44VE04A	**VE**	**Value Education – 4:** Social Ethics – 2*	2	1	50	50	50
		25UHE44VE04B		**Value Education – 4:** Religious Doctrine – 2*					
		25UNC44SE02 / 25UBT44SE02	**SEC**	**Skill Enhancement Course – 2:** NCC (Special Subject) / **Skill Enhancement Course – 2:** Mushroom Cultivation	2	1	100	-	100
		25UBT44SL03	**SL**	**Self Learing:** Environmental Biotechnology	-	2	50	50	50
	-	-	-	Extra Credit Course	-	(3)			
				Total	**30**	**22 (3)**			
5	III	25UBT53CC09	**CC Major**	**Core Course – 9:** Genomics and Proteomics	5	4	100	100	100
		25UBT53CC10		**Core Course – 10:** Food Biotechnology	5	3	100	100	100
		25UBT53CC11		**Core Course - 11:** Nanobiotechnology	5	3	100	100	100
		25UBT53CP05		**Core Practical - 5:** Genetics, Proteomics, Food Biotechnology and Nanobiotechnology	3	1	100	100	100
		25UBT53ES01A	**DSE**	**Discipline Specific Elective - 1:** Bioethics, IPR and Biosafety	4	3	100	100	100
		25UBT53ES01B		**Discipline Specific Elective - 1:** Cancer Biology					
		25UBT53ES02A		**Discipline Specific Elective - 2:** Research Methodology	4	3	100	100	100
		25UBT53ES02B		**Discipline Specific Elective - 2:** Cell Signaling					
		25UBT53IS01	**IS**	Internship	-	1	100	-	100
	IV	25UBT54OE01	**OE**	**Open Elective - 1(WS):** Traditional Medicine and Natural Products	4	2	100	100	100
		25UBT54SL04	**SL**	**Certificate Course:** Phytopharmaceuticals	-	2	100	-	100
	-	-	-	Extra Credit Course	-	(3)			
				Total	**30**	**22 (3)**			
6	III	25UBT63CC12	**CC Major**	**Core Course - 12:** Plant Biotechnology	6	5	100	100	100
		25UBT63CC13		**Core Course - 13:** Animal Biotechnology	6	4	100	100	100
		25UBT63CP06		**Core Practical - 6:** Plant Biotechnology	3	1	100	100	100
		25UBT63CP07		**Core Practical - 7:** Animal Biotechnology	3	1	100	100	100
		25UBT63ES03A	**DSE**	**Discipline Specific Elective - 3:** Molecular Diagnostics	4	3	100	100	100
		25UBT63ES03B		**Discipline Specific Elective - 3:** Biostatistics					
		25UBT63ES04A		**Discipline Specific Elective - 4:** Pharmaceutical Biotechnology	4	3	100	100	100
		25UBT63ES04B		**Discipline Specific Elective – 4:** Bio entrepreneurship					
		25UBT63EL01A / 25UBT63EL01B / 25UBT63EL01C	**EL**	**Project** / Industrial Visit / Field Visit	-	1	100	-	100
		25UBT63CE01	**CE**	Comprehensive Examination*	-	2	50	50	50
	IV	25UBT64OE02	**OE**	**Open Elective – 2:** Food Science and Technology	4	2	100	100	100
	-	-	-	Extra Credit Course	-	(3)			
				Total	**30**	**22 (3)**			
	V	25UCW65OR01	**OR**	Outreach Programme	-	4			
		25UCW65EC01	**EC**	Co - curricular and Extra curricular Activities	-	1			
1-6				**Total**	**180**	**137 (15)**			

***For Grade Calculation:** Marks obtained out of 50 will be converted into 100 in the mark statements.

Open Elective - 1 (WS): 5th Semester

School	Course Code	Title of the Course
SBS		
Botany	25UBO54OE01	Aquaculture
Biotechnology	25UBT54OE01	Traditional Medicine and Natural Products

Open Elective - 2: 6th Semester
Offered to students from other Departments

Department	Course Code	Title of the Course
Artificial Intelligence and Machine Learning	25UAI64OE02	Gen AI tools
Botany	25UBO64OE02	Landscape Designing and Waste Management
Biotechnology	25UBT64OE02	Food Science and Technology
BBA	25UBU64OE02A	Practical Stock trading
	25UBU64OE02B	Export Management
B Com Business Analytics	25UCB64OE02	Personal Investment Planning
B Com Computer Application	25UCC64OE02A	Social Media Marketing
	25UCC64OE02B	Basics of Banking
B Com Strategic Finance	25UCF64OE02	Personal Financial Management
Chemistry	25UCH64OE02	Food & Nutrition
B Com	25UCO64OE02A	Digital Marketing
	25UCO64OE02B	Digital Banking
	25UCO64OE02C	Stock Trading
Computer Science	25UCS64OE02	Design Thinking
BCA	25UBC64OE02	Web Design
Economics	25UEC64OE02	Economics for Competitive Exams
Electronics	25UEL64OE02A	CCTV and Smart Security Systems
	25UEL64OE02B	Entrepreneurial Electronics
English	25UEN64OE02	English for Employability
History	25UHS64OE02	Intellectual Revivalism in Tamil Nadu
Mathematics	25UMA64OE02	Mathematics for Competitive Examinations
Physics	25UPH64OE02A	Laser Technology and its Application
	25UPH64OE02B	Physics of Earth
Statistics	25UST64OE02	Applied Statistics
Tamil	25UTA64OE02	படைப்பிலக்கியம் (Creative writing)
Visual Communication	25UVC64OE02	Digital Media and Production

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UTA11GL01	பொதுத்தமிழ் – 1: General Tamil - 1	4	3

கற்றலின் நோக்கங்கள் (Course Objectives)
புதிய இலக்கிய வடிவங்களை அறியும் திறனைப் பெறுதல்
எழுத்து சொல் இலக்கணத்தில் இன்றியமையாமையை உணர்தல்
புதுக்கவிதைகளின் கூறுகளை வாழ்வியலோடு பொருத்திப்பார்த்தல்
தமிழ்க்கவிதைகளைப் பிறமொழிக் கவிதைகளோடு ஒப்பிட்டுப் பார்த்தல்
புதுக்கவிதைகளைப் படைக்கும் திறன் பெறுதல்

அலகு-1 **(12 மணி நேரம்)**

பாரதியார் கவிதைகள் - பாஞ்சாலிசபதம்: சபதச் சருக்கம்
பாரதிதாசன் கவிதைகள் - புரட்சிக்கவி : மன்னனின் சர்வாதிகாரம், கவிஞனின் எழுச்சியுரை, கவிஞனின் மொழிப்பற்று, மக்களாட்சி மலரும் விதம்
இலக்கிய வரலாறு - இருபதாம் நூற்றாண்டுத் தமிழ்க்கவிஞர்கள்
உரைநடை - முதல் மூன்று கட்டுரைகள்

அலகு-2 **(12 மணி நேரம்)**

வெ.இராமலிங்கனார் - தமிழ், அரசியல்
முடியரசனார் - தொழிலாளி, துறைதோறும் தமிழே காண்பீர், மொழியுணர்ச்சி
பெருஞ்சித்திரனார் - என்னென்று சொல்வோம், இனியேனும் ஒன்றிணைவீர்
பட்டுக்கோட்டையார் - என் விருப்பம், ஏட்டில் படித்ததோடு இருந்து விடாதே, அன்னசத்திரம் இருப்பதெதனாலே?
இலக்கிய வரலாறு - புதுக்கவிதை வடிவங்கள்
இலக்கணம் - எழுத்து

அலகு-3 : சமூகக் கவிதைகள் **(12 மணி நேரம்)**

சுரதா - நெஞ்சில் நிறுத்துங்கள், பூம்புகார்
மு. மேத்தா - உன்னுடைய கொடியை
கண்ணதாசன் - ஆணவம் அழியும்
அப்துல் ரகுமான் - பசி
தங்கம் மூர்த்தி - கூடு திரும்புதல் எளிதன்று
ஜெயபாஸ்கரன் - ஒற்றைக் கேள்வியுடன் ஒருவர்
இலக்கிய வரலாறு - சிறுகதை- உரைநடை
சிறுகதை - முதல் மூன்று கதைகள்

அலகு-4 : அரசியல் கவிதைகள் **(12 மணி நேரம்)**

ஈரோடு தமிழன்பன் - எட்டாவது சீர்
யுகபாரதி - பழைய புத்தக வியாபாரி
கனிமொழி - கருவறை வாசனை
அ. வெண்ணிலா - நீரில் அலையும் முகம்
பெருமாள் முருகன் - குழந்தைகளைத் தண்டித்தல்
சீனு ராமசாமி - அகதி
கல்கி சுப்பிரமணியம் - விதியை எழுதினேன்
இலக்கணம் - சொல்

அலகு-5 : அயலகக் கவிதைகள் **(12 மணி நேரம்)**

தஸ்லீமா நஸ்ரின் - கல் உடைக்கும் பெண்
மாயா ஏஞ்சலு - கைத்தட்டுங்கள் கொண்டாடுங்கள்
நானிலு கவிதைகள் - 10 கவிதைகள்
உரைநடை - நான்கு முதல் ஆறு வரை உள்ள கட்டுரைகள்
சிறுகதை - நான்கு முதல் ஆறு வரை உள்ள கதைகள்

கற்பித்தல் அணுகுமுறை Teaching Methodology	விரிவுரை **(Lecture),** காணொளிக் காட்சி **(Videos),** விளக்கக் காட்சி **(PPT presentation)**
மதிப்பீட்டு முறைகள் Assessment methods	நூல் நோக்குத் தேர்வு **(Open Book Test),** இயங்கலைத்தேர்வு **(**Online Test**),** ஒப்படைவு **(Assignment),** வினாடி வினா **(Quiz),** கருத்துரை **(Seminar)**

பாடநூல்:

பொதுத்தமிழ்-1(2025), தமிழாய்வுத்துறை, தூய வளனார் கல்லூரி

Websites and eLearning Sources:

- *https://www.tamilvu.org/library/nationalized/pdf/35-subbureddiyar/452-panjalisabatham.pdf*
- *https://www.annacentenarylibrary.org - https://shorturl.at/KWZx5*
- *https://eluthu.com/kavithai*
- *https://www.tamilvu.org/courses/degree/p103/p1032/html/p1032614.htm*
- *https://kavithaivaasal.blogspot.com/2017/11/blog-post.html*

Course Outcomes

CO No.	***CO-Statements*** ***இப்பாடத்தின் நிறைவில் மாணவர்கள்***	***Cognitive Levels (K –Levels)***
CO–1	இக்கால இலக்கிய வகைகளைக் கண்டறிவர்	***K1***
CO–2	எழுத்து, சொல்லிலக்கணங்களின் அடிப்படைகளை வகைப்படுத்தி அறிவர்.	***K2***
CO–3	அயலகக் கவிதை வடிவங்கள் குறித்த தெளிவான விளக்கங்களைப் பெறுவர்.	***K3***
CO–4	மொழிபெயர்ப்புக் கவிதைகளைக் கற்பதன் வாயிலாகத் திறனாய்வு செய்யும் திறனை வளர்த்தெடுப்பர்.	***K4***
CO–5	புதுக்கவிதை வாயிலாக வெளிப்படும் சமூக, அரசியல் விழுமியங்களை மதிப்பிடுவர்	***K5***

Relationship Matrix											
Semester	***Course Code***			***Title of the Course***						***Hours***	***Credits***
1	***25UTA11GL01***			பொதுத்தமிழ் – *1: General Tamil - 1*						***4***	***3***
Course Outcomes↓	***Programme Outcomes (PO)***					***Programme Specific Outcomes (PSO)***					***Mean Scores of COs***
	PO-1	***PO-2***	***PO-3***	***PO-4***	***PO-5***	***PSO-1***	***PSO-2***	***PSO-3***	***PSO-4***	***PSO-5***	
CO-1	*3*	*3*	*2*	*2*	*3*	*3*	*3*	*2*	*3*	*3*	*2.7*
CO-2	*2*	*2*	*3*	*2*	*2*	*3*	*2*	*3*	*2*	*3*	*2.4*
CO-3	*3*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*2*	*2.8*
CO-4	*2*	*2*	*2*	*2*	*1*	*2*	*2*	*3*	*2*	*2*	*2.0*
CO-5	*3*	*2*	*3*	*2*	*2*	*3*	*2*	*2*	*3*	*3*	*2.5*
										Mean Overall Score	***2.48 (High)***

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25UFR11GL01	Language French – 1	4	3

Course Objectives
Familiarize students with the French language through an exploration of francophone culture, traditions, and civilization.
Build fundamental knowledge in listening, speaking, reading, and writing (LSRW) as outlined by the Common European Framework of Reference for Languages (CEFR).
Enable students to understand and use basic grammatical structures and essential vocabulary in context.
Equip students with the skills needed to engage in simple, real-life conversations and interactions in French.
Foster a deeper connection to the language by integrating cultural elements, enhancing motivation and intercultural awareness.

UNIT I **(12 Hours)**

1. Titre - Je Suis
2. Lexique - L'alphabet, les salutations, les loisirs, les nombres
3. Grammaire - Les pronoms personnels sujets, les articles définis et indéfinis, les verbes auxiliaires, les adjectifs de nationalité, l'adjectif interrogatif 'quel'
4. Production orale- se présenter
5. Production écrite - Donner des informations personnelles

UNIT II **(12 Hours)**

6. Titre - Près de moi
7. Lexique – Les lieux, la famille, la situation familiale, les professions
8. Grammaire – les verbes en 'er'au présent, le masculin et le féminin des professions, les adjectifs possessifs
9. Production orale- Demander et dire le lieu d'habitation
10. Production écrite - Présenter et parler de sa famille

UNIT III **(12 Hours)**

11. Titre - Qu'est-ce qu'on mange ?
12. Lexique – les commerces, les commerçants, les aliments, les moyens de paiement
13. Grammaire – le singulier et le pluriel des noms, les prépositions de lieu, les verbes en 'ir'
14. Production orale- faire des courses alimentaires, demander et dire le prix
15. Production écrite - Donner une appréciation, commander au restaurant, créer un menu

UNIT IV **(12 Hours)**

16. Titre - C'est où
17. Lexique – la ville, les monuments, les transports
18. Grammaire – la fréquence, l'impératif, les connecteurs
19. Production orale- demander et indiquer le chemin, se déplacer des transports en commun
20. Production écrite - présenter une ville ou un quartier, créer un guide pour un monument

UNIT V **(12 Hours)**

21. Titre - C'est tendance
22. Lexique – les vêtements, les couleurs, les matières, les objets technologiques, la météo
23. Grammaire – le genre et le nombre des adjectifs, le futur proche, la place des adjectifs, l'adjectif démonstratif
24. Production orale- demander et dire l'utilité d'un produit, parler de la météo
25. Production écrite - Donner une appréciation sur un vêtement, décrire un objet
26. Indian knowledge system- Incorporating hand gestures and expressions to reinforce non-verbal communication in French and assimilating traditional Indian culinary knowledge while learning French food cultures (5%)

Teaching Methodology	Kinesthetic & Multi-Sensory Learning, Rhythm-Based Learning – ex. comptines, Deductive & Explicit Learning- structural approach, oral approach, blended learning, media integration
Assessment Methods	*Oral assessment:* Introduce Oneself – (Rubric –assessed on correct usage of vocabulary, personal pronouns and basic verbs) *TPR activity:* Evaluate comprehension of oral commands like action words. (Rubric –assessed on comprehension, response and reaction time) *Reading comprehension:* Read a simple passage like a personal description, and answer questions. (Rubric –assessed on accuracy of response) *Written assessment:* Write simple structured texts on short personal introduction. (Rubric –Graded on correct grammar, sentence structure, and vocabulary usage)

Book for Study:

1. Mensdorff-Pouilly, L., Opatski, S., Petitmengin, V., Pons, S., Sperandio, C., Djimli, H., & Veldeman-Abry, J. (2022). *Édito A1: Méthode de français* (2nd ed.). Didier FLE, Hatier. (P.1-P.86)

Book for Reference:

1. Dauda, P., Giachino, L., & Baracco, C. (2020). *Génération A1*. Didier.
2. Mérieux, R., &Loiseau, Y. (2012). *Latitudes A1*. Didier.

Websites and e-learning Sources:

1. https://apprendre.tv5monde.com/en
2. https://www.thefrenchexperiment.com
3. https://www.iletaitunehistoire.com
4. https://www.francaisfacile.com
5. https://www.francaisauthentique.com

	Course Outcomes	
CO No.	**CO–Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K –Levels)**
CO1	Recognize and use fundamental vocabulary including greetings, while constructing simple sentences with personal pronouns and basic verbs.	**K1**
CO2	Introduce themselves, ask and answer questions about personal details, express preferences, and engage in role-play conversations related to daily life	**K2**
CO3	Differentiate between definite and indefinite articles, form plural and singular nouns, conjugate regular verbs in the present tense, and use adjectives correctly	**K3**
CO4	Ask for and give directions, order food, discuss weather conditions, describe clothing and objects, and create simple structured texts such as menus, guides, and personal descriptions.	**K4**
CO5	Demonstrate awareness of Francophone culture through language use in real-world scenarios, such as public transport, shopping, dining, and professional settings.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**25UFR11GL01**			Language French – 1					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	1	3	2	1	1	2	3	1.9
CO2	3	2	3	3	1	3	2	3	3	3	2.6
CO3	2	2	2	2	2	2	1	2	2	2	1.9
CO4	3	3	3	3	2	3	2	2	2	3	2.6
CO5	3	2	2	3	3	3	3	2	3	3	2.7
Mean Overall Score											**2.34 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UHI11GL01	Language Hindi - 1	4	3

Course Objectives
To understand the basics of Hindi Language
To make the students to be familiar with the Hindi words
To enable the students to develop their effective communicative skills in Hindi
To introduce the socially relevant subjects in Modern Hindi Literature
To empower the students with globally employable soft skills

UNIT I **(12 Hours)**

1. Swar
2. Vyanjan
3. Barah Khadi
4. Shabd aur Vakya

UNIT II **(12 Hours)**

5. Rishtom ke Naam
6. Gharelu Padartho ke Naam
7. Sangya
8. Hindi Ginthi

UNIT III **(12 Hours)**

9. Sapthah ke Din
10. Sarvanam
11. Vilom Shabd
12. Dr. Abdul Kalam

UNIT IV **(12 Hours)**

13. Sal ke Maheene
14. Shareer ke Ang
15. Visheshan
16. Batcheeth - Dookan mein

UNIT V **(12 Hours)**

17. Janvarom ke Naam
18. Rang
19. Dishayem
20. Adhikal (Introduction)

Teaching Methodology	Peer Instruction Exercise, Videos, PPT, Quiz, Group Discussion
Assessment Methods	Seminar, Quiz, Assignment

Books for Study:

1. *Prathamic Patya Pusthak*, Dakshina Bharath Hindi Prachara Sabha, Thiagaraya Nagar, Chennai, 2022.
2. M. Ravi Chandran, *Concise Trilingual Dictionary*, Lotus Publications, Madurai, 2021.
3. M. kamathaprasad Gupth, *Hindi Vyakaran*, Anand Prakashan, Kolkatta, 2020.
4. *Madyama Patya Pusthak*, Dakshina Bharath Hindi Prachara Sabha, Thiagaraya Nagar, Chennai, 2022.

Books for Reference:

1. Dr. A. P. J. Abdul Kalam, *Mere sapnom ka Bharath*, Prabath Prakashan, Noida, 2020,
2. *Meri Pratham Hindi Sulekh Shabd Gyaan*, Wonder House Books, Noida, 2022.
3. Aravind Kumar, *Sampoorna Hindi Vyakaran our Rachana*, Lucent publisher, 2022.
4. *Adhunik Hindi Vyakaran our Rachana*, Bharati Bhavan Publishers & distributors, 2024.
5. Acharya Ramchandra Shukla, *Hindi Sahitya Ka Itihas*, Prabhat Prakashan, 2023.

Websites and e-Learning Sources:

1. https://learningmole.com/hindi-alphabet-letters-pronunciation-guide/
2. https://www.careerpower.in/hindi-alphabet-varnamala.html
3. https://www.youtube.com/watch?v=b0UvXnIC8qc
4. https://www.importanceoflanguages.com/learn-hindi-language-guide/
5. https://parikshapoint.com/hindi-sahitya/

Course Outcomes		
CO No.	**CO–Statements**	**Cognitive Levels (K –Levels)**
	On successful completion of this course, students will be able to	
CO1	Introduction to Hindi sounds.	**K1**
CO2	Acquisition of Hindi Vocabulary.	**K2**
CO3	Sentence formation in Hindi.	**K3**
CO4	Practical application of grammar.	**K4**
CO5	Justify the social & political conditions of Aadhi Kaal in Hindi Literature.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**				**Hours/week**			**Credits**
1	**25UHI11GL01**			Language Hindi - 1				**4**			**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scoreof Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	1	3	3	3	1	3	2	2.3
CO2	2	3	2	3	1	2	3	3	3	2	2.4
CO3	3	2	2	2	1	3	2	3	2	3	2.3
CO4	3	1	2	3	2	3	2	3	3	2	2.4
CO5	2	3	3	2	3	2	3	3	1	3	2.5
Mean overall Score											**2.38 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	**25USA11GL01**	Language Sanskrit - 1	**4**	**3**

Course Objectives
To improve knowledge in Sanskrit
To train students in reading Sanskrit words
To introduce the fundamental grammar
To coach ethics and improve self-confident
To train the students to use the tenses in Sanskrit

UNIT I **(12 Hours)**

Introduction to Sanskrit

UNIT II **(12 Hours)**

Subhandha shabda vicaraha (akaara, aakaara, ikaara, iikaara)

UNIT III **(12 Hours)**

Vartamankala lat lakaara vakya prayogaha

UNIT IV **(12 Hours)**

Samskrita sharala vakya paricayaha

UNIT V **(12 Hours)**

Selected verses from good saying in Sanskrit

Teaching Methodology	Videos, PPT, Blackboard, Demonstration, Exercises
Assessment Methods	Seminar, Quiz, Group Discussion.

Books for Study:

Shadhamanjari

Books for Reference:

1. Kulapathy, K.M., Sarala Samkrit Balabodh, Bharatiya Vidya Bhavan, Munushimarg Mumbai – 4000 007 2021
2. R.S. Vadhyar & Sons, Book – Sellers and publishers, Kalpathi. Palagahat 678003, Kerala, South Inida, Shabdha Manjari 2022
3. Balasubramaniam R, Samskrita Akshatra Siksha, Vangals Publications, 14th Main road, JP Nagar, Bangalore – 78 2020

Websites and e-Learning Sources:

1. https://www.learnsanskrit.org/static/pdf/vyakarana.pdf
2. https://archive.org/details/in.ernet.dli.2015.382597
3. https://openpathshala.com/sanskrit-grammar-basic/3

Course Outcomes		
CO No.	**CO–Statements**	**Cognitive Levels (K –Levels)**
	On successful completion of this course, students will be able to	
CO–1	Remember and Recall words relating to objects.	**K1**
CO–2	Understand classified vocabulary.	**K2**
CO–3	Apply nouns and verbs	**K3**
CO–4	Analyze different forms of names and verbs	**K4**
CO–5	Appreciate the good saying of Sanskrit Improve the self-values.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25USA11GL01**			Language Sanskrit - 1						**4**	**3**
Course Outcomes↓	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PS02**	**PSO3**	**PSO4**	**PSO5**	
CO-1	3	1	1	3	2	3	2	3	2	2	2.2
CO-2	2	2	3	3	1	2	2	3	3	2	2.3
CO-3	3	2	2	2	2	2	2	3	3	2	2.3
CO-4	3	2	2	3	2	3	3	3	2	2	2.3
CO-5	3	2	3	2	3	2	2	3	3	3	2.6
Mean Overall Score											**2.34 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UEN12GE01A	**General English – 1:** Pre-Intermediate Stream	5	3

Course Objectives (CO)
To develop basic listening, speaking, reading, and writing skills
To improve comprehension and fluency in both oral and written communication
To learn language rules to create meaningful written and spoken communication
To learn and integrate new vocabulary to expand language proficiency
To construct grammatically correct sentences and engage in simple conversations

UNIT I: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening for familiar words in stories
	(Practice)	**:**	"The City Mouse and the Country Mouse"
Reading:	**(Skill)**	**:**	Reading aloud
	(Practice)	**:**	"The Peacock and the Crane" "The Curious Monkey"
Grammar:	**(Practice)**	**:**	Nouns: Types; Gender
Vocabulary:	**(Practice)**	**:**	Kinship terms
Speaking:	**(Skill)**	**:**	Repetition of Minimal Pairs
	(Practice)	**:**	Pronunciation of words
Writing:	**(Skill)**	**:**	Using capital letters correctly in names, the pronoun 'I,' days, months, languages, nationalities, sentence beginnings, and book titles
	(Practice)	**:**	Capitalisation

UNIT II: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening to identify phrases and sentences
	(Practice)	**:**	"How to Be Happy in Every Situation"
Reading:	**(Skill)**	**:**	Reading for main ideas
	(Practice)	**:**	"The World is a Mirror"
Grammar:	**(Practice)**	**:**	Countable and Uncountable Nouns; Singular and Plural Nouns; Pronouns
Vocabulary:	**(Practice)**	**:**	Human body vocabulary
Speaking:	**(Skill)**	**:**	Responding to basic questions
	(Practice)	**:**	Simple conversations
Writing:	**(Skill)**	**:**	Writing personal and academic information with correct spelling
	(Practice)	**:**	Using Correct Spelling in Writing

UNIT III: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening for main ideas
	(Practice)	**:**	"Magic Pot"
Reading:	**(Skill)**	**:**	Identifying the message of the story
	(Practice)	**:**	Zen story: "Carry On" Zen story: "Harmony"
Grammar:	**(Practice)**	**:**	Adjectives, Articles and Verbs
Vocabulary:	**(Practice)**		Vegetables and Fruits
Speaking:	**(Skill)**		Using 'be' verbs and adjectives to describe people, things and pictures
	(Practice)		Describing People, Things and Pictures
Writing:	**(Skill)**	**:**	Practising correct punctuation in writing
	(Practice)	**:**	Punctuation

UNIT IV: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening for the main ideas in the story and expressing one's views about them
	(Practice)	**:**	"A Glass of Milk"
Reading:	**(Skill)**	**:**	Understanding the central idea of the story and sharing personal views

	(Practice)	**:**	"Birbal: The Wise Man"
Grammar:	**(Practice)**	**:**	Simple Present Tense
Vocabulary:	**(Practice)**	**:**	Plants, Trees and Flowers
Speaking:	**(Skill)**	**:**	Describing daily routines using the simple present tense
	(Practice)	**:**	Describing one's own routine and a friend's routine
Writing:	**(Skill)**	**:**	**Writing simple sentences in response to questions and on a given topic**
	(Practice)	**:**	Writing Simple Sentences

UNIT V: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening to understand the sequence of ideas
	(Practice)	**:**	A Father and His Son
Reading:	**(Skill)**	**:**	Identifying the implicit idea of the story
	(Practice)	**:**	"The Stone Cutter"
Grammar:	**(Practice)**	**:**	Simple Past Tense
Vocabulary:	**(Practice)**	**:**	Birds, Animals and Insects
Speaking:	**(Skill)**	**:**	Narrating stories, events, or experiences using the simple past tense
	(Practice)	**:**	Narrating a Familiar Story or Past Events
Writing:	**(Skill)**	**:**	Writing a paragraph using a picture by answering questions or describing it.
	(Practice)	**:**	Picture Composition

Teaching Methodology	Lectures, task-based activities, audio-visual listening tasks, guided reading and writing exercises, discussions
Assessment Method	Listening and reading comprehension exercises, verbal presentations, role plays and conversations, writing tasks

Books for Study:

Seeds of English Skills by Dr. M. John Britto, Dr. B. Sam Jerome Sharone, and Dr. S. Sajeev.

	Course Outcomes	
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
CO-1	Recognize basic sounds, words, and simple ideas through listening practice.	**K1**
CO-2	Understand and engage in simple conversations, improving fluency in both oral and written communication.	**K2**
CO-3	Apply grammatical rules to construct meaningful sentences in spoken and written forms.	**K3**
CO-4	Integrate new vocabulary into everyday communication to expand language proficiency.	**K4**
CO-5	Construct grammatically correct sentences and engage in simple conversations, expressing personal experiences and opinions.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25UEN12GE01A**			**General English – 1:** Pre-Intermediate Stream						**5**	**3**
Course Outcomes↓	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PS02**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	2	3	2	2	**2.4**
CO2	3	2	2	3	2	3	2	3	2	3	**2.5**
CO3	3	2	2	2	3	2	2	3	2	2	**2.3**
CO4	3	2	2	2	2	2	2	2	2	3	**2.2**
CO5	3	2	3	2	3	2	3	2	3	2	**2.5**
Mean Overall Score											**2.38 (High)**

Semester	Course Code	Title of the Course	Hours/ Week	Credits
1	25UEN12GE01B	**General English – 1:** Intermediate Stream	5	3

Course Objectives
To improve students' ability to listen, speak, read, and write in English through interactive and meaningful activities tailored to real-life contexts.
To enable students to use appropriate vocabulary, grammar, and pronunciation to introduce themselves, express opinions, describe people and places, and engage in conversations.
To equip students with reading strategies to comprehend texts, and apply structured writing methods to express ideas coherently.
To develop students' ability to use common grammar structures accurately and expand their vocabulary through word formation techniques.
To help students apply effective learning strategies to enhance their academic and professional success.

Unit 1: What's in a Name? (15 Hours)

1. Listening:	**(Skill)**	Listening for gist
	(Practice)	"Not Good with Names" by Cynthia Win (a TED talk)
2. Reading:	**(Skill)**	Skimming
	(Practice)	"Eli, the Equation"
3. Grammar:	**(Practice)**	Nouns
4. Vocabulary:	**(Practice)**	Forming compound nouns
5. Study Skill:		Using online dictionaries
6. Speaking:	**(Skill)**	Initiating conversations (Greeting – Starting a conversation with new people – Introducing and answering an introduction)
	(Practice)	Introducing oneself and others in conversations
7. Writing:	**(Skill)**	Narrating a personal anecdote – Using capitals and end mark punctuations in sentences
	(Practice)	Guided Composition: The story of my name

Unit 2: Family is Forever! (15 Hours)

1. Listening:	**(Skill)**	Predicting topics
	(Practice)	"Tracing Roots, Telling Stories"
2. Reading:	**(Skill)**	Scanning
	(Practice)	"Home Lost, Family Found"
3. Grammar:	**(Practice)**	Pronouns
4. Vocabulary:	**(Practice)**	Words related to family and relationships
5. Study Skill:		Recognising your learning style
6. Speaking:	**(Skill)**	Talking about your family (family members and relationships, their personalities and your attachment, family routines, and challenges)
	(Practice)	Talking about your family (in conversations)
7. Writing:	**(Skill)**	Narrating events in chronological order – Using punctuations in numbers
	(Practice)	Controlled Composition: My family history

Unit 3: Nothing is Better than a Good Friend (15 Hours)

1. Listening:	**(Skill)**	Listening for main idea
	(Practice)	"Nothing is better than a good friend"
2. Reading:	**(Skill)**	Predicting
	(Practice)	(Jigsaw reading) Fables about friends: (a) "The Hare with Many Friends" – (b) "The Two Fellows and the Bear" – (c) "The Fox and the Stork" – (d) "The Four Friends and a Hunter"
3. Grammar:	**(Practice)**	Adjectives
4. Vocabulary:	**(Practice)**	Forming nouns, adjectives, verbs and adverbs using suffixes
5. Study skill:		Setting and prioritising language learning goals
6. Speaking:	**(Skill)**	Talking about people (Describing people's appearance and their mannerism – Giving your opinion about people – Expressing what you like and dislike in a person)
	(Practice)	Delivering a short talk about one's best friend

7. Writing:	**(Skill)**	Describing people (What they wear, how they move and seem to feel, and where they are) Using comma in sentences.
	(Practice)	Controlled composition: Describing people in given pictures

Unit 4: The Inner Me **(15 Hours)**

1. Listening:	**(Skill)**	Listening to understand pronunciation
	(Practice)	"The bare necessities" from *The Jungle Book*
2. Reading:	**(Skill)**	Previewing a text
	(Practice)	"The Surprising Benefits of Being an Introvert"
3. Grammar:	**(Practice)**	Articles and Quantifiers
4. Vocabulary:	**(Practice)**	Forming words with different meanings using prefixes
5. Study skill:		Planning a study schedule
6. Speaking:	**(Skill)**	Asking about feelings – Expressing one's feelings
	(Practice)	Talking about feelings in different situations
7. Writing:	**(Skill)**	Describing character traits (Writing about what characters would say or do) Using quotation marks and apostrophes in sentences
	(Practice)	Controlled Composition: Cruel Cinderella

Unit 5: Hometown Appetite **(15 Hours)**

1. Listening:	**(Skill)**	Listening for supporting details
	(Practice)	"The Village that Raised Me"
2. Reading:	**(Skill)**	Questioning circles for active reading
	(Practice)	"Homecoming"
3. Grammar:	**(Practice)**	Prepositions of time, place and movement
4. Vocabulary:	**(Practice)**	Changing words from one class to another
5. Study skill:		Tracking progress in learning
6. Speaking:	**(Skill)**	Describing a place
	(Practice)	Talking about your hometown
7. Writing:	**(Skill)**	Describing objects – Using colon in sentences
	(Practice)	Controlled Composition: Writing posts for social media, describing your college campus and classroom

Teaching Methodology	Lectures, Demonstrations, Discussions, Peer-Review Tasks, Role-plays, Pair and group activities
Assessment Tools	Listening and reading comprehension tasks, Individual talks, Role plays, Controlled and guided compositions

Books for Study:

M.S. Xavier Pradheep Singh, J. Amalaveenus, and A. Napoleon. *English and Me* by Viva Books, 2025.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify and recall common grammar structures, vocabulary, and pronunciation patterns used in everyday communication.	**K1**
CO2	Demonstrate comprehension of spoken and written texts by summarising key ideas, identifying main points, and making inferences.	**K2**
CO3	Use appropriate vocabulary, grammar, and pronunciation to introduce themselves, express opinions, describe people and places, and engage in meaningful conversations.	**K3**
CO4	Differentiate between various reading and writing strategies, such as skimming, scanning, and structured writing, to effectively interpret and construct texts.	**K4**
CO5	Critically review written and spoken texts for clarity, coherence, and correctness, providing constructive feedback for improvement.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
1	**25UEN12GE01B**		**General English – 1:** Intermediate Stream						**5**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2.5	3	3	2.5	3	3	2.5	2.5	3	2.8
CO2	2.5	3	2.5	2.5	2.5	3	3	2.5	2.5	3	2.7
CO3	3	2.5	2.5	3	3	2.5	2.5	2.5	3	2.5	2.7
CO4	2.5	2.5	2.5	3	2.5	2.5	2.5	3	2.5	2.5	2.6
CO5	3	2.5	2.5	2.5	3	2.5	2.5	2.5	3	2.5	2.65
Mean Overall Score											**2.69 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UBT13CC01	**Core Course - 1:** Cell Biology	5	4

Course Objectives
To understand the fundamental structure and diversity of cells.
To explore the dynamic nature and transport mechanisms of cellular membranes.
To study the structure and functions of organelles involved in metabolism.
To analyze energy metabolism processes in mitochondria and chloroplasts.
To examine cell division, signaling pathways, and communication mechanisms.

UNIT I **(15 Hours)**

Fundamentals of Cell Structure: Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).

UNIT II **(15 Hours)**

Cellular Membranes and Matrices: Chemical composition and fluidity of membranes; lipid bilayer and membrane protein. Dynamic nature of membranes; membrane potentials; transportation across the cell membrane; Diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, Extracellular matrices – structure and function; cytoskeleton – structure and function.

UNIT III **(15 Hours)**

Cellular Organelles in Metabolism: Endoplasmic reticulum (ER)– smooth & rough; functions of ER; Golgi complex – structure and function; Ribosomes – Types, structure and function; Morphology and functions of peroxisomes and glyoxisomes; Plant cell vacuoles; endocytic pathways – endocytosis, phagocytosis; membrane trafficking.

UNIT IV **(15 Hours)**

Cellular Organelles in Energy Metabolism: Mitochondria –Morphology – structural variations; Chemical compositions and Functions; Enzyme system of Mitochondria; Chloroplast – structure and function. Import and Sorting of Chloroplast Proteins. Photosynthesis.

UNIT V **(15 Hours)**

Cell Division and Cell Signaling: Cell Cycle**,** Cell cycle check points - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extra Cellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.

Teaching Methodology	Chart, PPT, chalk and talk
Assessment Methodology	Assignment, Seminar, Posters, Group discussion, Class Tests

Books for Study:

1. Watson JD, Gilman M, Witkowski J and Zoller M. 2010. Recombinant DNA. Scientific American Books. 4th Edition. New York.
2. Blackburn GM and Gait MJ. 2006. Nucleic Acids in Chemistry and Biology. Oxford University Press. 3. Lodish H, Baltimore D, Beck A, Zipursky SL, Matsudaria P and Darnell J. 2007. Molecular Cell Biology. 4th Edition. Scientific American Books.
3. Cooper M. 2007. The Cell- A Molecular Approach. 2nd Edition. ASM Press.

Books for Reference:

1. Lewis JK and Valerie M Kish. 1995. Principle of Cell and Molecular Biology 2nd Edition. Benjamin-Cummings Publishing Company.
2. De Robertis, EDP and E.M.F Robertis. 1987. Cell and Molecular Biology. 8th Edition. Saunders Company.
3. Brown. T.A. 2011. Introduction to genetics: A molecular approach. 1st Edition. Garland Science. 8.
4. Meyers, R. A. (Ed.). (1996). Molecular biology and biotechnology: a comprehensive desk reference. John Wiley & Sons.

Websites and eLearning Sources:

1. https://www.cellbio.com/education.php
2. https://www.onlinebiologynotes.com
3. https://thebiologynotes.com/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recall the fundamental structure, diversity, and theory of cells.	**K1**
CO2	Demonstrate the composition, fluidity, and transport mechanisms of cellular membranes and matrices.	**K2**
CO3	Explain the roles of cellular organelles in metabolic and endocytic pathways.	**K3**
CO4	Compare and contrast the structure, function, and energy metabolism processes of mitochondria and chloroplasts.	**K4**
CO5	Assess the regulation of the cell cycle, cell division, and signaling pathways for cellular communication.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25UBT13CC01**			**Core Course - 1**: Cell Biology						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	3	2	3	2	1	**2.3**
CO3	2	2	3	2	1	3	3	2	3	1	**2.2**
CO4	3	3	2	3	2	3	3	2	3	2	**2.6**
CO5	2	2	3	2	1	3	2	3	2	1	**2.1**
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UBT13CC02	**Core Course - 2:** Microbiology	5	4

Course Objectives
To understand the history, scope, and contributions of microbiology, including microbial ecology and fermentation.
To learn the principles of media preparation, sterilization techniques, and factors affecting microbial growth.
To study the structural organization and ultrastructure of bacteria, including their specialized structures.
To explore the diversity, ultrastructure, and reproduction of algae and fungi.
To examine the characteristics, structure, and life cycles of protozoa, viruses, viroids, and prions.

UNIT I **(15 Hours)**

General Introduction to Microbiology: History of Microbiology, Scope and Relevance of Microbiology, Discovery of Microorganisms. Conflict over Spontaneous generation. The golden age of Microbiology, Development of Industrial Microbiology and Microbial Ecology. Concept of fermentation. Scope and applications of microbiology –Contributions of scientists in the field of microbiology.

UNIT II **(15 Hours)**

Media Preparation and Sterilization: Media Composition and their types based on physical state & ingredients. Microbial Growth- Factors influencing the growth of Microorganisms – Growth Curve.

UNIT III **(15 Hours)**

Bacteria: Structural organization of bacteria – Size, shape and arrangement of bacterial cells – Ultrastructure of a bacterial cell – cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores, cysts, plasmid, mesosomes and cytoplasmic inclusions.

UNIT IV **(15 Hours)**

Diversity of Algae and Fungi: General characteristics of Algae (*Chlamydomonas sp*) including occurrence, thallus organization, Ultra structure, pigments, flagella, eyespot, food reserves. Reproduction – Sexual and Asexual reproduction. Fungi (*Aspergillus*sp) – General characteristics of fungi including habitat, distribution, nutritional requirements, Ultrastructure, thallus organization and aggregation.

UNIT V **(15Hours)**

Protozoa & Viruses: General characteristics with special reference to Amoeba, Paramecium and Giardia. Viruses: Viruses, viroids and prions - A general introduction with special reference to the structure of the following: TMV, poliovirus. Lytic and lysogenic cycle.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Assignment, Seminar, Posters, Group discussion, Class Tests

Books for Study:

1. Tortora, G. J., Case, C. L., & Funke, B. R. 2016. Microbiologia-12ª Edi Microbiology: An Introduction. Pearson Education.
2. Pommerville, J. C., & Pommerville, J. C. 2011. Alcamo's fundamentals of microbiology. Jones & Bartlett Learning.
3. Black, J. G., & Black, L. J. (2018). Microbiology: principles and explorations. John Wiley & Sons.
4. Gillespie, S. H., & Hawkey, P. M. (Eds.). (2006). Principles and practice of clinical bacteriology. John Wiley & Sons.

Books for Reference:

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). Brock Biology of Microorganisms. 15th Global Edition. Boston, US: Benjamin Cummins, 1, 1391- 1407.
2. Prescott, Harley and Klein (2016). McGraw Hill. Microbiology. 10thEdition.
3. Pelczar, Chan and Kreig (2016). McGraw-Hill. Microbiology 9thEdition.

4. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2016). Microbiologia de Brock-14ª Edição. Artmed Editora.
5. Cowan, M. K., & Talaro, K. P. (2009). Microbiology: a systems approach. McGraw-Hill Higher Education.

Websites and eLearning Sources:

1. https://archive.nptel.ac.in/courses/102/103/102103015/
2. https://www.youtube.com/watch?v=Bhe6Tj2Ebys
3. https://microbiologynotes.com/category/basic-microbiology/
4. https://byjus.com/biology/microbiology/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recognize the history, scope, and significance of microbiology, along with key contributions of scientists.	**K1**
CO2	Describe the principles of media preparation, sterilization, and microbial growth patterns.	**K2**
CO3	Identify the structural components of bacterial cells and explain their functions.	**K3**
CO4	Compare the characteristics, organization, and reproductive strategies of algae and fungi.	**K4**
CO5	Explain the structure, replication and pathogenicity of protozoa, viruses, viroids, and prions.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
1	**25UBT13CC02**		**Core Course - 2:** Microbiology						**5**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	2	2	**2.3**
CO2	2	3	2	3	3	2	3	2	2	2	**2.4**
CO3	2	2	3	2	3	3	3	2	3	3	**2.7**
CO4	3	3	2	1	2	3	2	3	1	2	**2.3**
CO5	2	3	2	2	3	2	3	2	2	3	**2.6**
										Mean Overall Score	**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UBT13CP01	**Core Practical - 1:** Cell Biology and Microbiology	3	1

Course Objectives
To learn the preparation and identification of blood smears and blood cells.
To study the morphological characteristics of various plant tissue cells.
To identify Barr bodies using buccal smears for cytogenetic analysis.
To observe and analyze the process of mitosis in onion root tip cells.
To perform cell counting, viability assays, and enumeration of eukaryotic cells like RBCs and WBCs.

Experiments

Cell Biology

1. Blood smear preparation and Identification of Blood cells.
2. Morphological Characterization of various types of Plant tissue cells.
3. Barr body identification from Buccal Smear.
4. Observation of Mitosis in Onion root tip cells.
5. Cell Counting and viability in Yeast Cells
6. Enumeration of Eukaryotic Cells - Red Blood Cells
7. Enumeration of Eukaryotic Cells - White Blood Cells

Microbiology

1. Sterilization – glassware & media – wet, dry & filtration.
2. Preparation of Microbiological media.
3. Isolation of microorganisms from various samples.
4. Biochemical identification of bacteria.
5. Staining of bacteria – Simple & differential staining – Gram's and Spore Staining.
6. Culture Techniques - Pure culture - slant, stab, streak etc.
7. Maintenance and storage of bacterial strains.
8. Measurement of Bacterial Growth – turbidometric method.

Teaching Methodology	PPT, micro slide preparation, models, Chalk and talk, diagrams
Assessment Methodology	Model practical exam, Viva, Observation, Lab Performance

Books for Study:

1. Trigunayat, M. M., Trigunayat, K. (2019). A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part-1. Scientific Publishers.
2. Amit, G., Bipin Kumar, S. (2019). Practical Laboratory Manual – Cell Biology. Lambert Academic Publishing.
3. Hubel, A. (2018). Preservation of cells: a practical manual. John Wiley & Sons.
4. Das, D. (2017). ESSENTIAL PRACTICAL HANDBOOK OF CELL BIOLOGY & GENETICS, BIOMETRY & MICROBIOLOGY: A LABORATORY MANUAL. Academic Publishers.
5. Rybicki, E. (2014). A Manual of Online Molecular Biology Techniques. University of Cape Town.

Books for Reference:

1. David A. Thompson. 2011. Cell and Molecular Biology Lab Manual. Create Space Independent Publishing Platform'
2. Harley, J., & P Harley, J. (2002). Laboratory exercises in microbiology. The McGraw − Hill.
3. Gunasekaran, P. (2007). Laboratory manual in microbiology. New Age International

Websites and eLearning Sources:

1. https://youtu.be/Izk1QMg8190 5.
2. https://youtu.be/IR5jps-xmzA

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Recall the techniques for preparing blood smears and identifying blood cells.	**K1**
CO2	Explain the morphological characteristics of various plant tissue cells and their significance.	**K2**
CO3	Perform Barr body identification from buccal smears for cytogenetic analysis.	**K3**
CO4	Examine the stages of mitosis in onion root tip cells and interpret the findings.	**K4**
CO5	Assess cell viability and enumerate eukaryotic cells such as RBCs, WBCs, and yeast cells.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25UBT13CP01**			**Core Practical - 1:** Cell Biology and Microbiology						**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	3	2	3	2	1	**2.3**
CO3	2	2	3	2	1	3	3	2	3	1	**2.2**
CO4	3	3	2	3	2	3	3	2	3	2	**2.6**
CO5	2	2	3	2	1	3	2	3	2	1	**2.1**
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UBT13AC01	**Allied Course - 1:** Chemistry of Biomolecules	4	3

Course Objectives
To understand acids, bases, pH, buffers, and water properties in biological systems.
To study carbohydrate classification, properties, metabolism, and bioenergetics.
To explore protein and amino acid structure, classification, and energy metabolism.
To learn lipid and nucleic acid classification, metabolism, and biological roles.
To analyze the roles, sources, and deficiencies of vitamins and minerals.

UNIT I **(12 Hours)**

Basics of Biochemistry: Acids & Bases properties and differences, Concepts of acids and bases. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson - Hasselbalch equation. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water.

UNIT II **(12 Hours)**

Fundamentals of Carbohydrates and its Classification: Classification of carbohydrates. Properties of carbohydrates. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Glycolysis, Gluconeogenesis TCA cycle, bioenergetics of carbohydrate metabolism.

UNIT III **(12 Hours)**

Introduction to Proteins and Amino acids: Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. ATP production. Oxidative phosphorylation, Electron transport chain.

UNIT IV **(12 Hours)**

Overview of Lipids and Nucleic acids: Classification of Lipids. Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. β -oxidation of fatty acids. Classification of nucleic acids. Classification of DNA & RNA.Purine and Pyrimidine biosynthesis.

UNIT V **(12 Hours)**

Vitamins and Minerals: Vitamins - Source, structure, biological role, daily requirement and deficiency manifestation of vitamin A, B, C, D, E and K. Minerals: Requirements, macro and micro minerals - source and functions.

Teaching Methodology	PPT, videos, demonstration using specimens, models and charts.
Assessment Methodology	Assignment, Seminar, Posters, Group discussion, Class Tests

Books for Study:

1. Singh, S. P., Singh, A. N. (2021). Textbook of Biochemistry. CBS Publishers.
2. Gupta, S. N. (2020). Concepts of Biochemistry. Rastogi Publications.
3. Sathyanarayana, U., Chakrapani, U. (2020). Biochemistry, 5th Edition. Elsevier Publishers.
4. Seema Pavgi, U. (2020). Textbook of Biochemistry.1st Edition. Dreamtech Press.
5. Padmaja Agarkar, H., Yogesh, K. & Rammohan, R. (2020). Biochemistry. Nirali Prakashan Publishers.

Books for Reference:

1. Manzoor Malik, M. (2021). Fundamentals of Biochemistry. LAP Lambert Academic Publishing.
2. Vikrant, V. (2021). Biochemistry. Discovery Publishing House Pvt Ltd.
3. Brailsford Robertson, T. (2020). Principles of Biochemistry. MJP Publishers.
4. Jeremy Berg, M., Stryer, L., Tymoczko, J., Gatto, G. (2019). Biochemistry. Freeman and Company.
5. Dean Appling, R., Spencer Anthony, J., Cohill, C., Christopher Mathews, K. (2017). Biochemistry Concepts and Connections. Pearson Education.

Websites and eLearning Sources:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=422
2. https://nptel.ac.in/courses/102105034/
3. https://youtu.be/DhwAp6yQHQI
4. https://agrimoon.com/fundamentals-of-biochemistry-pdf-book/
5. http://courseware.cutm.ac.in/courses/fundamentals-of-biochemistry/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Define the concepts of acids, bases, pH, buffers, and the unique properties of water in biological systems.	**K1**
CO2	Explain the classification, properties, and metabolic pathways of carbohydrates, including glycolysis, TCA cycle, and gluconeogenesis.	**K2**
CO3	Illustrate the structural classification, biological importance, and degradation of proteins and amino acids, including the urea cycle and ATP production.	**K3**
CO4	Compare and contrast the properties, metabolism, and biological roles of lipids and nucleic acids, including purine and pyrimidine biosynthesis.	**K4**
CO5	Assess the significance, sources, and deficiency effects of vitamins and minerals in human health.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25UBT13AC01**			**Allied Course - 1:** Chemistry of Biomolecules						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	3	2	3	2	1	**2.3**
CO3	2	2	3	2	1	3	3	2	3	1	**2.2**
CO4	3	3	2	3	2	3	3	2	3	2	**2.6**
CO5	2	2	3	2	1	3	2	3	2	1	**2.1**
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UBT13AP01	**Allied Practical - 1:** Chemistry of Biomolecules	2	1

Course Objectives
To understand the principles of units, measurements, and solution preparation techniques.
To learn the preparation of molarity, normality solutions, and buffers for biochemical analysis.
To analyze carbohydrates such as glucose, sucrose, and starch through qualitative methods.
To estimate glucose and protein concentrations using DNS and Bradford's methods, respectively.
To separate plant pigments using paper chromatography techniques.

Experiments

1. Units and Measurements.
2. Preparation of Molarity, Normality solutions and Buffers.
3. Qualitative analysis of carbohydrates Glucose.
4. Qualitative analysis of carbohydrates Sucrose.
5. Qualitative analysis of carbohydrates Starch.
6. Qualitative analysis of amino acids.
7. Estimation of glucose - DNS method
8. Estimation of proteins – Bradford's method
9. Separation of plant pigments using Paper chromatography

Teaching Methodology	Charts, slides, specimens, models and mounting dissection.
Assessment Methodology	Model practical exam, Viva, Observation, Lab Performance

Books for Study:

1. Dr. J. Jayaraman, 2011. Manuals in Biochemistry, New Age International Pub, Bangalore.
2. Plummer, 2000. Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company.
3. Evangeline, J. (2022). Manual of Practical Medical Biochemistry. 3rd edition. Jaypee Brothers Medical Publishers.
4. Chawla, R. (2020). Practical Clinical Biochemistry: Methods and Interpretations. JP Medical Ltd.
5. Kaushik, G.G., Neha, S., Sabira, D., Ruchi, J. (2020). Practical Manual of Biochemistry. CBS Publishers and Distributors

Books for Reference:

1. Gupta, R.C., Bhargava, S. (2018). Practical Biochemistry. 5th Edition. CBS Publishers.
2. Plummer, D. T. (2017). An Introduction to Practical Biochemistry. 3rd Edition. Tata McGraw-Hill Education.
3. Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers.

Websites and eLearning Sources:

1. https://biotech01.vlabs.ac.in/List%20of%20experiments.html
2. https://vlab.amrita.edu/?sub=3&brch=63&sim=156&cnt=1
3. https://www.vrlabacademy.com/Experiments/501/Medical-Biochemistry-Laboratory.html
4. https://www.asbmb.org/education/online-teaching/online-lab-work

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Define the principles of units, measurements, and solution preparation techniques.	**K1**
CO2	Describe the procedures for preparing molarity, normality solutions, and buffers.	**K2**
CO3	Illustrate the qualitative analysis of carbohydrates and amino acids in samples.	**K3**
CO4	Interpret results from carbohydrate tests and biomolecule estimation methods.	**K4**
CO5	Validate the separation of plant pigments using paper chromatography techniques.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**25UBT13AP01**			**Allied Practical - 1:** Chemistry of Biomolecules						**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	3	2	3	2	1	**2.3**
CO3	2	2	3	2	1	3	3	2	3	1	**2.2**
CO4	3	3	2	3	2	3	3	2	3	2	**2.6**
CO5	2	2	3	2	1	3	2	3	2	1	**2.1**
									Mean Overall Score		**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25UHE14VE01	**Value Education - 1:** Essentials of Humanity	2	1

Course Objectives
To identify one's own potentials, strengths and weaknesses
To identify various challenges (physical, emotional and social) in adolescence
To consciously overcome one's challenges and move towards self-esteem
To maximize one's own potential in enabling holistic development
To assimilate human values comprehensively

UNIT I: Value Education (6 Hours)

Introduction to values - Characteristics and Roots of Values - Value Education & Value Clarification - Moral Characters - Kinds of Values - Objectives of Values

UNIT II: Human Personality (6 Hours)

Personality: Introduction, Traits, Theories, Integration & Factors influencing the development of personality - Discovering self - Defense Mechanism -Power of positive thinking - Why worry?

UNIT III: Human Development (6 Hours)

Areas of Development: Physical, Intellectual, Emotional, Social Development, Moral & Spiritual development – Practical Sessions on Health and Wellness

UNIT IV: Responsible Parenthood (6 Hours)

Human Sexuality - Marriage and Family - Sex and Love - Characteristics of Responsible parent - Causes of Marriage disharmony - Art of wise parenting

UNIT V: Gender Equality and Empowerment (6 Hours)

Historical perspective - Women in Independence struggle - Women in Independent India - Education & Economic development - Crimes against Women - Women rights - Time-line of Women achievements in India

Teaching Methodology	Power point
Assessment Methods	Seminars, Reports, Group Discussion, Online Tests, Assignments

Books for Study:

1. Department of Human Excellence. (2023). *Essentials of Humanity.* St. Joseph's College.

Books for Reference:

1. Alex, K. (2009). *Soft Skills.* S. Chand.
2. Norman Vincent Peale (1952). *The Power of Positive Thinking Norman Vincent Peale.* New York Times
3. Kalam, A.A. P. J. (2012). *You Are Unique.* Punya Publishing.

Websites and eLearning Sources:

1. http://livingvalues.net. Accessed 05 March 2021.
2. https://www.psychologytoday.com/us/basics/defense-mechanisms.Accessed 12 March 2025.
3. http://www.apa.org/topics/personality#. Accessed 05 March 2021.
4. http://www.peacecorps.gov/educators/resources/global-issues-gender-equaligy-and-womens-empowerment/. Accessed 05 March 2021.
5. https://www.nextias.com/blog/women-empowerment/Accessed 12 March 2025.

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Recall the prescribed values and the dimensions.	**K1**
CO2	Examine themselves by learning the developmental changes happening in the course of their lifetime.	**K2**
CO3	Apply the trained values in the day-to-day life.	**K3**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
1	**25UHE14VE01**			**Value Education - 1:** Essentials of Humanity					**2**	**1**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	2	3	3	**2.8**
CO2	3	2	2	3	3	2	3	3	2	2	**2.5**
CO3	2	3	3	3	2	3	3	3	3	3	**2.8**
										Mean Overall Score	**2.7 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UTA21GL02	பொதுத்தமிழ் – 2: General Tamil - 2	4	3

கற்றலின் நோக்கங்கள் (Course Objectives)
காப்பியங்களின் தோற்றம், வரையறை, வகைகள் ஆகியவற்றை அறிந்து கொள்ளல்
பெருங்காப்பியம், சிறுகாப்பியம் இடையேயான வேறுபாட்டைக் கண்டறிதல்
சைவ வைணவ சமயப் பாடல்களில் சிறப்பினை ஒப்பிடுதல்
காப்பியங்கள் வெளிப்படுத்தும் விழுமியங்களையும் உணர்தல்
சமூகத்திற்கும், காப்பியத்திற்குமான பிணைப்புகள் குறித்துத் தெரிந்துகொள்ளுதல்

அலகு-1 **(12 மணி நேரம்)**

சிலப்பதிகாரம் - ஆய்ச்சியர் குரவை
மணிமேகலை – ஊர் அலர் உரைத்த காதை
இலக்கிய வரலாறு – சைவம் வளர்த்த தமிழ் முதல் புராணங்கள் முடிய
இலக்கணம் – அகப்பொருள் இலக்கணம்

அலகு-2 **(12 மணி நேரம்)**

திருநாவுக்கரசர் – திருவதிகை வீரட்டானம்
(கூற்றாயினவாறு எனத் தொடங்கும் முதல் 10 பாடல்கள்)
திருவாசகம் - அடைக்கலப்பத்து
(செழுக்கமலத் திரளனநின் எனத் தொடங்கும் முதல் 10 பாடல்கள்)
திருமந்திரம் – மாகேசுர பூசை (11 பாடல்கள்)
சிவவாக்கியர் பாடல்கள் (15 பாடல்கள்)
பாடல் எண்கள் – 16,22,27,33,34,35,37,38,47,81,91,225,237,242,495

அலகு-3 **(12 மணி நேரம்)**

பெரியாழ்வார் திருமொழி – திருப்பல்லாண்டு – தாலப்பருவம் (10 பாடல்கள்
திருமங்கையாழ்வாரின் பெரிய திருமொழி – திருவரங்கம் -1 (10 பாடல்கள்)
கம்பராமாயணம் – கங்கை காண் படலம் - (தேர்ந்தெடுக்கப்பட்ட 35 பாடல்கள்)
பாடல் எண்கள்: 1, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 22, 24, 25, 26, 27, 29, 30, 32,33,35,39,40,41,42,43,47,62,64,65,67,69,70
நற்றமிழ்க் கோவை – முதல் மூன்று கட்டுரைகள்.

அலகு-4 **(12 மணி நேரம்)**

சீறாப்புராணம் – நதி கடந்த படலம் – 1 முதல் 31 முடிய உள்ள பாடல்கள்
கள்வரை நதிமறித்த படலம் – 1 முதல் 16 முடிய உள்ள பாடல்கள்
இலக்கணம் – புறப்பொருள் இலக்கணம்
இலக்கிய வரலாறு – தமிழ் இலக்கண நூல்கள் முதல் சிற்றிலக்கியங்கள் முடிய

அலகு-5 **(12 மணி நேரம்)**

வீரமாமுனிவரின் தேம்பாவணி – (காசா) காசை சேர் படலம்
(1 முதல் 50 முடிய உள்ள பாடல்கள்)
சீனயி (சீனாய்) - மாமலை காண்படலம் -(1 முதல் 56 முடிய உள்ள பாடல்கள்)
நற்றமிழ்க் கோவை – இறுதி மூன்று கட்டுரைகள்.

கற்பித்தல் முறை (Teaching Methods)	விரிவுரை **(Lecture),** காணொளிக் காட்சி **(Videos),** விளக்கக் காட்சி **(PPT presentation)**
மதிப்பீட்டு முறைகள் (Assessment Pattern)	இயங்கலைத்தேர்வு **(Online Test),** நூல் நோக்குத் தேர்வு (open book test) ஒப்படைவு **(Assignment),** வினாடி வினா **(Quiz),** கருத்துரை **(Seminar)**

பாடநூல்கள்:

1. பொதுத்தமிழ் (2025), தமிழாய்வுத்துறை, தூய வளனார் கல்லூரி
2. நற்றமிழ்க் கோவை - கட்டுரைத்தொகுப்பு (2025), தமிழாய்வுத்துறை வெளியீடு, தூய வளனார் கல்லூரி

Websites and eLearning Sources:

1. https://www.tamiluniversity.ac.in/english/library2-/digital-library/
2. https://www.tamilvu.org/ta/library-l3100-html-l3100pl1-132372
3. https://www.tamilvu.org/ta/courses-degree-p202-p2021-html-p202121-28011
4. https://www.chennailibrary.com/vaishnava/naalayiradivyaprabhandham.html

5. https://www.tamilvu.org/ta/library-l4310-html-l4310por-141616
6. https://www.tamilvu.org/slet/l4100/l4100pd2.jsp?bookid=80&pno=287

Course Outcomes

CO No.	CO–Statements **இப்பாடத்தின் நிறைவில் மாணவர்கள்**	Cognitive Levels (K –Levels)
CO–1	பழந்தமிழர் வாழ்வியலையும் பன்முக ஆளுமைகளையும் அறிவர்	K1
CO–2	தமிழரின் பல்துறை அறிவு, மரபு போன்றவற்றை அறிந்து கொள்வர்.	K2
CO–3	பெருங்காப்பிய மரபிற்குள் வரும் இலக்கியங்களை அடையாளம் காண்பதோடு அவற்றை விளக்கும் திறனையும் பெறுவர்.	K3
CO–4	புராண இதிகாச மரபுகளிலிருந்து, காப்பியம் என்னும் புதிய இலக்கிய வடிவம் உருவான விதத்தை மதிப்பிடுவர்.	K4
CO–5	இலக்கிய வரலாறு, இலக்கணம், காப்பியங்கள் ஆகியவற்றைக் கற்பதன் வழி போட்டித் தேர்வுகளை எதிர்கொள்ளும் திறன் பெறுவர்	K5

Relationship Matrix											
Semester	Course Code			Title of the Course						Hours	Credits
2	25UTA21GL02			பொதுத்தமிழ் – 2: General Tamil -2						4	3
Course Outcomes↓	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	3	2	3	3	3	3	3	3	3	2.8
CO-2	3	2	2	2	2	3	3	3	2	2	2.4
CO-3	2	3	1	3	1	3	3	3	1	2	2.2
CO-4	3	3	2	3	1	3	3	3	1	3	2.5
CO-5	3	3	2	2	3	3	3	2	2	2	2.5
Mean Overall Score											2.48 (High)

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**25UFR21GL02**	Language French – 2	**4**	**3**

Course Objectives
Develop Communicative Competence in French enabling students to engage in simple, real-life conversations and interactions
Master Fundamental Grammar and Vocabulary by understanding and applying essential grammatical structures in context
Explore Francophone Culture and Civilization by integrating cultural elements of French-speaking regions
Enhance Practical Language Use in Everyday Situations
Express Ideas in Different Contexts Using Appropriate Tenses

UNIT I **(12 Hours)**

1. Titre - Qu'est-ce qu'on fait aujourd'hui ?
2. Lexique –l'heure, les activités quotidiennes, la description physique
3. Grammaire –les verbes pronominaux au présent, le passé récent, la fréquence
4. Production orale- demander l'heure, proposer une sortie
5. Production écrite - présenter ses activités quotidiennes, décrire une personne

UNIT II **(12 Hours)**

6. Titre - Chez -moi
7. Lexique – le logement, les meubles, les pièces, l'équipement
8. Grammaire – le passe compose avec avoir, les pronoms COD
9. Production orale- s'informer sur un logement
10. Production écrite - expliquer un problème domestique, écrire une annonce pour un logement

UNIT III **(12 Hours)**

11. Titre - En forme
12. Lexique – les parties du corps, les maladies, les médicaments, les sports
13. Grammaire –Le passé composé avec être, le pronom 'y',
14. Production orale- parler de sa santé, exprimer une émotion positive
15. Production écrite - Donner un conseil, exprimer son accord ou son désaccord

UNIT IV **(12 Hours)**

16. Titre - Bonne vacances
17. Lexique – les destinations, l'hébergement, la réservation, la nature
18. Grammaire – la comparaison, les verbes impersonnels à l'imparfait comme c'était
19. Production orale- réserver une chambre a l'hôtel, décrire une ville ou un paysage
20. Production écrite - réaliser une brochure touristique, écrire une carte postale

UNIT V **(12 Hours)**

21. Titre - Au travail
22. Lexique – les études, les disciplines, les lieux de travail, les taches
23. Grammaire – la durée, les pronoms relatifs
24. Production orale- parler de ses études et son projet professionnel
25. Production écrite - comparer le système scolaire français et indien
26. Indian knowledge system–Highlighting on Gurukulam Education System that focuses on traditional teacher-student relationships, oral learning methods, and holistic education while discussing education systems in India vs. France (5%)

Teaching Methodology	Visual-Linguistic Learning, Descriptive & Interpretative Learning, experiential learning, The Lexical Approach, Differentiated Instruction
Assessment Methods	*Role -play:* A mock phone call on hotel reservation, discuss daily routines, housing, and health. (Rubric – graded on grammatical accuracy, and use of appropriate vocabulary) *Picture description activity:* Describe a landscape or travel destination shown in a picture. (Rubric – Assessed on descriptive abilities and vocabulary use) *Experimental learning task:* Doctor-patient conversation about a health issue, Conduct a mock interview about career plans. (Rubric – Assessed on real-life application of language skills) *Project based assessment*: Create a travel brochure for a French-speaking destination, make a poster comparing education in France and India (Rubric – Assessed on Application of language skills in a creative way) *Written assessment*: Write a short daily routine using time expressions, write a postcard describing a recent trip (Rubric – Assessed on ability to write structured texts related to themes)

Books for Study:

1. Mensdorff - Pouilly, L., Opatski, S., Petitmengin, V., Pons, S., Sperandio, C., Djimli, H., & Veldeman - Abry, J. (2022). *Édito A1: Méthode de français* (2nd ed.). Didier FLE, Hatier. (p.87-p.165)

Books for Reference:

1. Dauda, P., Giachino, L., & Baracco, C. (2020). *Génération A1*. Didier.
2. Mérieux, R., &Loiseau, Y. (2012). *Latitudes A1*. Didier.

Websites and eLearning Sources:

1. https://www.podcastfrancaisfacile.com
2. https://www.flevideo.com
3. https://savoirs.rfi.fr/fr
4. https://www.french4me.net/
5. https://apprendre.tv5monde.com/en

Course Outcomes		
CO No.	**CO–Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K –Levels)**
CO1	Talk about daily routines, tell the time, describe people, and propose social outings using appropriate vocabulary and verb structures.	**K1**
CO2	Inquire about housing, describe household items, explain domestic issues, and write advertisements or announcements for accommodations.	**K2**
CO3	Describe body parts, discuss health conditions, give advice, express emotions, and use past tense structures to narrate past experiences.	**K3**
CO4	Make hotel reservations, describe destinations and landscapes, compare experiences, and write postcards or travel brochures.	**K4**
CO5	Discuss education, career plans, and workplace responsibilities while comparing educational systems in France and India.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**25UFR21GL02**			Language French – 2					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	1	2	2	2	3	2	2	1.9
CO2	2	2	2	3	1	3	3	2	3	3	2.4
CO3	2	3	2	1	2	2	1	3	2	1	1.9
CO4	3	2	2	2	2	3	2	1	2	3	2.2
CO5	3	3	3	2	3	2	3	2	3	2	2.6
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**25UHI21GL02**	Language Hindi - 2	**4**	**3**

Course Objectives
To understand the basics of Hindi Language
To make the students to be familiar with the Hindi words
To enable the students to develop their effective communicative skills in Hindi
To introduce the socially relevant subjects in Modern Hindi Literature
To empower the students with globally employable soft skills

UNIT I **(12 Hours)**

1. Moun hi Manthra Hay
2. Letter Writing - Chutti Patra
3. Bakthikal - Namakarn
4. Sarkari Kariyalayom Ka Naam

UNIT II **(12 Hours)**

5. Baathcheeth - Aspathal Mein
6. Letter Writing - Rishthedarom ko Patra
7. Bakthikal - Samajik Paristhithiyam
8. Kriya

UNIT III **(12 Hours)**

9. Premchand
10. Kriya visheshan
11. Letter Writing - Naukari Keliye Avedan Patra
12. Bakthikal - Sahithyik Paristhithiyam

UNIT IV **(12 Hours)**

13. Kabeer ke Dohae
14. Samas
15. Letter Writing - Kitab Maangne Keliye Patra
16. Bakthikal - Salient Features, Main Division

UNIT V **(12 Hours)**

17. Anuvad
18. Sandhi
19. Bakthikal - Visheshathayem
20. Apathit Gadyansh

Teaching Methodology	Peer Instruction Exercise, Videos, PPT, Quiz, Group Discussion
Assessment Methods	Group Discussion, Seminar, Snap Test

Books for Study:

1. Viswanath Tripaty. *(2021). Kuchh Kahaniyan*, Rajkamal Prakashan Pvt. Ltd.
2. Kamathaprasad Gupth, M. (2020). *Hindi Vyakaran*. Anand Prakashan.
3. Dr. Sadananth Bosalae. *(2020). kavya sarang*, Rajkamal Prakashan.

Books for Reference:

1. Acharya Ramchandra Shukla. (2021). *Hindi Sahitya Ka Itihas*. Prabhat Prakashan.
2. Krishnakumar Gosamy. (2023). *Anuvad vigyan ki Bhumika*. Rajkamal Prakashan.
3. Aravind Kumar. (2022). *Sampoorna Hindi Vyakaran our Rachana*, Lucent publisher.
4. Lakshman Prasad Singh. (2021). *Kavya ke sopan*. Bharathy Bhavan Prakashan.

Websites and e-Learning Sources:

1. https://hindigrammar.in/sandhi.html
2. https://www.successcds.net/class10/hindi/samas-in-hindi

3. https://mycoaching.in/kriya-ke-bhed-verb-in-hindi
4. https://namastesensei.in/adverb-in-hindi-examples/
5. https://viahindi.in/hindi-vyakaran/sandhi-paribhasha-prakar-or-udaharan

Course Outcomes		
CO No.	**CO–Statements** On successful completion of the course, the student will acquire thelisted skills	**Cognitive Levels (K-Levels)**
CO1	Find out the Terms & Expressions related to letter writing.	**K1**
CO2	Providing knowledge of Letter writing in Hindi.	**K2**
CO3	Complete the sentences in Hindi using basic grammar.	**K3**
CO4	Analyze the social & political conditions of Devotional period in Hindi Literature.	**K4**
CO5	Justify the human values stressed on the works of Hindi writers	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**				**Hours/ week**		**Credits**	
2	**25UHI21GL02**			Language Hindi – 2				**4**		**3**	
Course Outcomes (Cos)	**Programme Outcomes (Pos)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	3	3	2	2	2.5
CO2	1	3	1	2	2	3	3	3	2	3	2.3
CO3	3	2	3	2	2	3	2	3	2	2	2.4
CO4	2	3	3	1	3	2	3	2	1	2	2.2
CO5	3	2	2	2	3	2	3	2	3	2	2.4
Mean Overall Score											**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**25USA21GL02**	Language Sanskrit - 2	**4**	**3**

Course Objectives
To bring out the salient aspects of classical Sanskrit poetry
To introduce court epics in Sanskrit
To train students in declensions of pronouns in Sanskrit
To coach the students in the conjugation patterns of verbs in Sanskrit
To offer coaching in morpho-phonemic rules and their applications in Sanskrit

UNIT I **(12 Hours)**

Asmathi usmath tat kim (MFN) sarva naama sabdaha

UNIT II **(12 Hours)**

Sandhi Niyamaah Abhyaash (Guna, Visarga, Dirgha, Vrddhi)

UNIT III **(12 Hours)**

Lang lakaarah Kriyapadaani Prayoga Vivaranam

UNIT IV **(12 Hours)**

Raguvamsaha Pratama sargaha (1 –15 slokas)

UNIT V **(12 Hours)**

Suvacanani Vakya Prayoga Vivaranam

Teaching Methodology	Videos, PPT, Blackboard, Demonstration, Exercises
Assessment Methods	Seminar, Quiz, Group Discussion.

Books for Study:

1. Saralasamkritham Siksha ,2021
2. Dhaatu Rupa Manjari ,2021

Books for Reference:

1. Paindrapuram Ashram, Srirangam – 620 006 Gopalavimshanthi 2021
2. R.S.Vadhyar & Sons book – Seller and Publishers , Kalpathi , Palghat – 678003 , Kerala , South Inida, shabdha manjari
3. Kulapthy, K.M Saral sankrit Balabodh, Bharathiys Vidya Bhavan, Munshimarg Mumbai – 400007, 2020

Websites and eLearning Sources:

1. https://www.meritnation.com
2. https://www.aplustopper.com
3. https://mycoaching.in/lang-lakar
4. https://sanskritdocuments.org/sites/giirvaani/giirvaani/rv/sargas/01_rv.htm
5. https://resanskrit.com/blogs/blog-post/sanskrit-shlok-popular-quotes-meaning-hindi-english

Course Outcomes		
CO No.	**CO–Statements**	**Cognitive Levels (K –Levels)**
	On successful completion of this course, students will be able to	
CO–1	Remembering names of different objects, remembering different verbal forms and sandhi	**K1**
CO–2	Contrast different verbal forms Explain good sayings, Relate good saying to life.	**K2**
CO–3	Apply and build small sentences	**K3**
CO–4	Analyze different forms of Verbs and nouns	**K4**
CO–5	Appreciate subhashitas and Sanskrit poetry	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25USA21GL02**			Language Sanskrit - 2						**4**	**3**
Course Outcomes↓	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO-1	2	1	3	2	2	2	3	3	2	1	2.1
CO-2	3	2	3	2	2	3	2	3	3	2	2.5
CO-3	2	2	3	2	2	2	2	3	3	1	2.1
CO-4	3	2	3	3	1	2	3	3	3	1	2.4
CO-5	3	2	2	2	3	2	2	3	3	1	2.3
Mean Overall Score											**2.28 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UEN22GE02A	**General English – 2:** Pre-Intermediate Stream	5	3

Course Objectives (CO)
To strengthen listening and speaking skills for identifying key ideas and details
To improve reading comprehension and analyze different texts
To express ideas clearly in conversations and presentations, using correct grammatical structures.
To develop writing skills by creating clear and structured texts
To assess and improve language use in both spoken and written communication

UNIT I: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening to respond to story-based questions
	(Practice)	**:**	"The Hare and His Friends"
Reading:	**(Skill)**	**:**	Understanding and interpreting proverbs
	(Practice)	**:**	"Necessity is the Mother of Invention"
Grammar:	**(Practice)**	**:**	Present Continuous Tense; Past Continuous Tense
Vocabulary:	**(Practice)**	**:**	Weather and Seasons
Speaking:	**(Skill)**	**:**	Describing on-going actions in the present and the past to describe real-life situations and activities
	(Practice)	**:**	Ongoing Actions: Present & Past
Writing:	**(Skill)**	**:**	Writing a biography of a famous personality using given details
	(Practice)	**:**	Writing a Biography

UNIT II: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening to identify factual details
	(Practice)	**:**	Recycling
Reading:	**(Skill)**	**:**	Reading to convert a story into a meaningful dialogue
	(Practice)	**:**	The Shepherd and the Stranger
Grammar:	**(Practice)**	**:**	Future Expressions: Simple Future & 'Going to'; Simple Present, Present Continuous and Future Continuous Tenses
Vocabulary:	**(Practice)**	**:**	Groceries
Speaking:	**(Skill)**	**:**	Developing conversational fluency by practising conversations on familiar and everyday topics
	(Practice)	**:**	Conversations on Familiar and Everyday Topics
Writing:	**(Skill)**	**:**	Writing clear, respectful and relevant online comments
	Practice	**:**	Writing Online Comments

UNIT III: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening for specific information
	(Practice)	**:**	Telephonic Conversation
Reading:	**(Skill)**	**:**	Reading a news report
	(Practice)	**:**	Iron Age in Tamil Nadu Began 5,300 Years Ago
Grammar:	**(Practice)**	**:**	Present Perfect Tense; Past Perfect Tense
Vocabulary:	**(Practice)**	**:**	Kitchen Utensils and Household Appliances
Speaking:	**(Skill)**	**:**	Using polite expressions in conversations to request, seek permission, grant or refuse permission, and apologise
	(Practice)	**:**	Polite Expressions in Conversations
Writing:	**(Skill)**	**:**	Expressing short reflective ideas in writing
	(Practice)	**:**	Thought for the Day

UNIT IV: **(15 Hours)**

Listening:	**(Skill)**	**:**	Predicting content and vocabulary before listening
	(Practice)	**:**	Our Earth
Reading:	**(Skill)**	**:**	Identifying direct and indirect speech
	(Practice)	**:**	Birbal story: "Hot Iron Test"

Grammar:	**(Practice)**	**:**	Active and Passive Voice
Vocabulary:	**(Practice)**	**:**	Human Diseases
Speaking:	**(Skill)**	**:**	Using polite expressions in conversations to interrupt, make suggestions, and agree or disagree
	(Practice)	**:**	Polite Expressions in Conversations
Writing:	**(Skill)**	**:**	Writing a report on a given topic
	(Practice)	**:**	Report Writing

UNIT V: **(15 Hours)**

Listening:	**(Skill)**	**:**	Listening to understand formal speeches
	(Practice)	**:**	"A Tryst with Destiny" by Jawaharlal Nehru
Reading:	**(Skill)**	**:**	Reading to understand an essay
	(Practice)	**:**	"Secularism"
Grammar:	**(Practice)**	**:**	Adverbs; Prepositions
Vocabulary:	**(Practice)**	**:**	**Occupations**
Speaking:	**(Skill)**	**:**	Delivering a short prepared speech on a familiar or inspiring topic
	(Practice)	**:**	Delivering a Short Speech
Writing:	**(Skill)**	**:**	Writing a clear and well-structured essay on a given topic
	(Practice)	**:**	Essay Writing

Teaching Methodology	Lectures, task-based activities, audio-visual listening tasks, guided reading and writing exercises, discussions
Assessment Method	Listening and reading comprehension exercises, verbal presentations, role plays and conversations, writing tasks

Books for Study:

Dr. M. John Britto, Dr. B. Sam Jerome Sharone, and Dr. S. Sajeev. *Nurturing English Skills*. Emerald Publishers, 2025.

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recognize key ideas and details in spoken and written texts, demonstrating effective listening and comprehension skills.	**K1**
CO2	Understand and interpret different types of texts, enhancing reading comprehension and critical thinking abilities.	**K2**
CO3	Apply correct grammatical structures to express ideas clearly in conversations and presentations.	**K3**
CO4	Analyze and organize ideas to write clear, coherent, and well-structured texts for various purposes.	**K4**
CO5	Evaluate and improve language use, refining both spoken and written communication.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**				**Hours**		**Credits**	
2	**25UEN22GE02A**			**General English – 2:** Pre-Intermediate Stream				**5**		**3**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	2	3	2	2	**2.4**
CO2	3	2	2	3	2	3	2	3	2	3	**2.5**
CO3	3	2	2	2	3	2	2	3	2	2	**2.3**
CO4	3	2	2	2	2	2	2	2	2	3	**2.2**
CO5	3	2	3	2	3	2	3	2	3	2	**2.5**
Mean Overall Score											**2.38 (High)**

Semester	Course Code	Title of the Course	Hours/ Week	Credits
2	25UEN22GE02B	**General English – 2:** Intermediate Stream	5	3

Course Objectives
To develop students' ability to listen, speak, read, and write effectively in English through interactive and contextualised activities.
To improve students' understanding and application of essential grammar concepts, including verb usage, auxiliary verbs, modals, adverbs, and sentence structures.
To equip students with strategies to deduce meanings of unfamiliar words using contextual clues.
To foster students' ability to brainstorm, organise information using graphic organisers, and structure written communication effectively for academic and professional contexts.
To enable students to engage in discussions, express opinions, seek and provide information, and navigate real-life situations confidently through role plays.

Unit 1: My College & Studies **15 Hours**

1. Listening:	**(Skill)**	Distinguishing between main ideas and supporting details
	(Practice)	"A Day in the Life of a College Student" (A conversation)
2. Reading:	**(Skill)**	Recognising the structure of written texts
	(Practice)	"Enter to learn, leave to serve"
3. Grammar:	**(Practice)**	Main Verb
4. Vocabulary:	**(Practice)**	Using synonyms as contextual clues to guess the meaning of unfamiliar words
5. Study skill:		Brainstorming to gather ideas in a group
6. Speaking:	**(Skill)**	Asking for, giving and refusing permission – Requesting – Communication repair: Finding about pronunciation, spelling and meaning.
	(Practice)	Role Play
7. Writing:	**(Skill)**	Writing an outline
	(Practice)	Controlled composition: Writing an outline for a given passage

Unit 2: Travel **15 Hours**

1. Listening:	**(Skill)**	Listening for specific details
	(Practice)	"A Perfect Vacation" (A conversation)
2. Reading:	**(Skill)**	Identifying main ideas and supporting details
	(Practice)	"An Unforgettable Ride"
3. Grammar:	**(Practice)**	Auxiliary Verbs
4. Vocabulary:	**(Practice)**	Using antonyms as contextual clues to guess the meaning of unfamiliar words
5. Study skill:		Mind mapping to visually organise information
6. Speaking:	**(Skill)**	Asking for and giving directions – Asking for and giving information
	(Practice)	Role Play
7. Writing:	**(Skill)**	Writing effective paragraphs
	(Practice)	Free-writing composition: An adventurous journey

Unit 3: My Social Network **15 Hours**

1. Listening:	**(Skill)**	Understanding the sequence of ideas
	(Practice)	"My Virtual Friends" (A conversation)
2. Reading:	**(Skill)**	Comprehending infographics
	(Practice)	"Social Media Etiquette
3. Grammar:	**(Practice)**	Modal Auxiliary Verbs
4. Vocabulary:	**(Practice)**	Using definitions and restatements as contextual clues to guess the meaning of unfamiliar words
5. Study skill:		Using graphic organisers (sequence of events chain, timeline, and storyboard)
6. Speaking:	**(Skill)**	Asking for and giving advice – Asking if someone agrees – Agreeing and disagreeing – Warning someone
	(Practice)	Role Play

7. Writing:	**(Skill)**	Developing stories from hints
	(Practice)	Controlled composition: Developing a story from given hints

Unit 4: Shopping **15 Hours**

1. Listening:	**(Skill)**	Detecting signposts
	(Practice)	"Let's go shopping!" (A conversation)
2. Reading:	**(Skill)**	Recognising transition of ideas
	(Practice)	"Adventures of the Grocery Store"
3. Grammar:	**(Practice)**	Adverbs and WH Question Words
4. Vocabulary:	**(Practice)**	Using examples and illustrations as contextual clues to guess the meaning of unfamiliar words
5. Study skill:		Using graphic organisers (Venn diagram, and cause-and-effect map)
6. Speaking:	**(Skill)**	Offering and accepting help – Asking for and giving opinions – Asking for and saying one's preference – Suggesting – Complaining
	(Practice)	Role Play
7. Writing:	**(Skill)**	Describing actions in a story
	(Practice)	Guided composition: Narrating a story in a comic strip

Unit 5: Ceremonies **15 Hours**

1. Listening:	**(Skill)**	Listening to intonations
	(Practice)	"Happy Birthday to You!" (A conversation)
2. Reading:	**(Skill)**	Understanding moods in a reading passage
	(Practice)	"The Light has Gone out" by Jawaharlal Nehru
3. Grammar:	**(Practice)**	Sentences
4. Vocabulary:	**(Practice)**	Using root words as clues to guess the meaning of words
5. Study skill:		Using graphic organisers (idea wheel, idea web, and concept map)
6. Speaking:	**(Skill)**	Using intonations for different types of sentences – Expressing your feelings and emotions – Congratulating and wishing someone – Expressing sympathy
	(Practice)	Role Play
7. Writing:	**(Skill)**	Expressing emotions in narrative writing
	(Practice)	Controlled composition: Describing emotions and feelings conveyed in a picture story

Teaching Methodology	Lectures, Demonstrations, Discussions, Peer-Review Tasks, Role-plays, Pair and group activities
Assessment Tools	Listening and reading comprehension tasks, Individual talks, Role plays, Controlled and guided compositions

Books for Study:

M.S. Xavier Pradheep Singh, Amalaveenus, and A. Napoleon. English and My World, 2025.

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Identify key ideas, supporting details, and organisational patterns in spoken and written texts.	**K1**
CO2	Explain the meaning of conversations and passages by recognising their structure, tone, and purpose.	**K2**
CO3	Use appropriate language functions such as requesting, suggesting, and expressing opinions effectively in real-life interactions.	**K3**
CO4	Compare different communication styles and linguistic features in various types of texts and conversations.	**K4**
CO5	Assess the effectiveness of spoken and written communication, providing constructive feedback for improvement.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25UEN22GE02B**			**General English – 2:** Intermediate Stream						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO-1	3	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	3	2.65
CO-2	2.5	3	2.5	2.5	2.5	3	3	2.5	2.5	3	2.7
CO-3	3	2.5	2.5	3	2.5	2.5	2.5	2.5	3	2.5	2.65
CO-4	2.5	2.5	2.5	3	2.5	2.5	2.5	3	2.5	2.5	2.6
CO-5	3	2.5	2.5	2.5	3	2.5	2.5	2.5	3	2.5	2.65
Mean Overall Score											**2.65 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UBT23CC03	**Core Course - 3:** Molecular Biology	4	4

Course Objectives
To understand the structure, properties, and roles of DNA and RNA as genetic materials.
To study the mechanisms and enzymology of DNA replication and repair processes.
To explore the processes of transcription and translation in prokaryotes and eukaryotes.
To analyze gene regulation mechanisms in prokaryotes and eukaryotes, including operon systems and hormonal control.
To learn the methods and significance of genetic exchange processes like transformation, transduction, and conjugation.

UNIT I **(12 Hours)**

Genetic Material: DNA and RNA as genetic material, Characters of a genetic material, Chemistry & Molecular structure of DNA, Topology of DNA, Structure and types of RNA. Bacterial chromosome, Organization of genes in prokaryotes.

UNIT II **(12 Hours)**

Replication: Replication of DNA – Replication in prokaryotes– Mechanism & enzymology of replication – Theta replication & Rolling circle replication. DNA repair mechanism

UNIT III **(12 Hours)**

Gene Expression: Transcription – Prokaryotic & Eukaryotic Transcription. Enzymes involved in Transcription - RNA polymerase. Post-transcriptional processing in mRNA (5' cap), 3' – end polyadenylation, splicing. Translation - Mechanism of translation in Prokaryotes and genetic code.

UNITIV **(12 Hours)**

Gene Regulation: In prokaryotes: lac operon and trp operon & attenuation. In eukaryotes: gene loss, gene amplification, gene rearrangement. Regulation of synthesis of primary transcripts, transcriptional control by hormones.

UNIT V **(12 Hours)**

Genetic exchange: Transduction (specialized & generalized), Transformation, Conjugation and Genetic recombination**.**

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methods	Seminar, Snap Test, MCQ, Assignments

Books for Study:

1. Watson JD, Gilman M, Witkowski J, Zoller M. (1992). Recombinant DNA. Scientific American Books.
2. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2008). Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Laboratory Press, Pearson Publication.
3. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India 15.
4. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK

Books for Reference:

1. Freifelder, D. (2008). *Molecular Biology,* (2nd Ed.). Narosa Publications.
2. Alberts, B.*etal.* (2015). *Molecular Biology of Cell*,(6thEd.).Taylor and Francis Group, Garland Science.
3. Karp, G. (2008). *Cell and Molecular Biology,* (5thEd.). John Wiley and Sons.
4. Paul, A. (2011). *Text book of Cell and Molecular Biology*. Books and Allied Ltd.

Websites and eLearning Sources:

1. https://www.web-books.com/MoBio/Free/Chap1.htm 17
2. https://www.web-books.com/MoBio/Free/Chap7.htm 18.

3. https://www.web-books.com/MoBio/Free/Chap5.htm

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify the structure, characteristics, and types of DNA and RNA, along with gene organization in prokaryotes.	**K1**
CO2	Explain the mechanisms of DNA replication, repair processes, and enzymology involved.	**K2**
CO3	Demonstrate transcription, post-transcriptional modifications, and translation processes in prokaryotic and eukaryotic systems.	**K3**
CO4	Examine gene regulation mechanisms in prokaryotes (e.g., lac and trp operons) and eukaryotes, including transcriptional control.	**K4**
CO5	Analyze genetic exchange processes like transduction, transformation, and conjugation, and their significance in genetic recombination.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25UBT23CC03**			**Core Course - 3:** Molecular Biology						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	3	2	2	2	2	**2.2**
CO2	3	2	2	2	2	3	2	2	2	2	**2.2**
CO3	3	2	2	2	2	2	3	2	1	2	**2.1**
CO4	2	3	2	2	1	3	2	3	2	2	**2.2**
CO5	2	3	2	3	3	2	3	2	2	1	**2.3**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UBT23CC04	**Core Course - 4:** Developmental Biology	4	3

Course Objectives
To introduce the fundamental concepts and scope of developmental biology.
To explain the cellular and molecular mechanisms of gametogenesis, fertilization, and embryogenesis.
To describe the processes of cleavage, gastrulation, and germ layer differentiation.
To analyze organogenesis, behavioral development, and extraembryonic structures.
To explore plant developmental processes, including pollination, fertilization, and meristem organization.

UNIT I **(12 Hours)**

Gametogenesis and Fertilization: Introduction, scope, and history of developmental biology. Gametogenesis (spermatogenesis, oogenesis) and fertilization mechanisms. Types of eggs based on yolk content and their significance.

UNIT II **(12 Hours)**

Early Embryonic Development: Cleavage patterns, blastulation types, and gastrulation movements (epiboly, emboly, invagination, etc.). Formation and differentiation of primary germ layers. Role of morphogenetic movements in embryonic patterning.

UNIT III **(12 Hours)**

Embryonic Differentiation: Concepts of cell commitment, determination, and differentiation. Genetic control of differentiation and epigenetic landscape model. Regulation of gene expression during development.

UNIT IV **(12 Hours)**

Organogenesis: Neurulation and vertebrate eye development. Fate of different germ layers, development of behavior, and plasticity. Formation of extraembryonic membranes and mammalian placenta.

UNIT V **(12 Hours)**

Plant Development: Development of microsporangium and megasporangium, pollination, and embryo sac formation. Double fertilization, seed germination, and experimental embryology. Organization of shoot/root apical meristems and leaf development.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methods	Seminar, Snap Test, MCQ, Assignments

Books for Study:

1. Tortora, G. J., Case, C. L., & Funke, B. R. 2016. Microbiologia-12ª Edi Microbiology: An Introduction. Pearson Education.
2. Pommerville, J. C., & Pommerville, J. C. 2011. Alcamo's fundamentals of microbiology. Jones & Bartlett Learning.
3. Black, J. G., & Black, L. J. (2018). Microbiology: principles and explorations. John Wiley & Sons.
4. Gillespie, S. H., & Hawkey, P. M. (Eds.). (2006). Principles and practice of clinical bacteriology. John Wiley & Sons.

Books for Reference:

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). Brock Biology of Microorganisms. 15th Global Edition. Boston, US: Benjamin Cummins, 1, 1391- 1407.
2. Prescott, Harley and Klein (2016). McGraw Hill. Microbiology. 10thEdition.
3. Pelczar, Chan and Kreig (2016). McGraw-Hill. Microbiology 9thEdition.
4. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2016). Microbiologia de Brock-14ª Edição. Artmed Editora.
5. Cowan, M. K., & Talaro, K. P. (2009). Microbiology: a systems approach. McGraw-Hill Higher Education.

Websites and eLearning Sources:

1. https://archive.nptel.ac.in/courses/102/103/102103015/
2. https://www.youtube.com/watch?v=Bhe6Tj2Ebys
3. https://microbiologynotes.com/category/basic-microbiology/
4. https://byjus.com/biology/microbiology/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recall the key stages of embryonic and plant development.	**K1**
CO2	Explain the mechanisms of gametogenesis, fertilization, and differentiation.	**K2**
CO3	Apply knowledge of morphogenetic movements in embryonic patterning.	**K3**
CO4	Analyze the roles of genetic and environmental factors in organogenesis.	**K4**
CO5	Evaluate experimental techniques in developmental biology for research applications.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**25UBT23CC04**			**Core Course - 4:** Developmental Biology					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	2	2	**2.3**
CO2	2	3	2	3	3	2	3	2	2	2	**2.4**
CO3	2	2	3	2	3	3	3	2	3	3	**2.7**
CO4	3	3	2	1	2	3	2	3	1	2	**2.3**
CO5	2	3	2	2	3	2	3	2	2	3	**2.6**
										Mean Overall Score	**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UBT23CP02	**Core Practical - 2:** Molecular Biology and Developmental Biology	3	1

Course Objectives
To demonstrate techniques for the isolation and purification of genomic DNA from prokaryotes and eukaryotes.
To perform agarose gel electrophoresis for DNA observation and quantification of nucleic acids.
To understand protein separation techniques such as SDS-PAGE and protein staining methods.
To observe and analyze developmental stages using prepared slides of frog, chick embryos, and seed germination.
To investigate the effects of different conditions on pollen and seed germination, linking them to developmental processes.

Molecular Biology

1. Isolation and purification of genomic DNA from prokaryotes.
2. Isolation and purification of genomic DNA from eukaryotes.
3. Observation of DNA - Agarose gel electrophoresis.
4. Quantification of nucleic acids – DNA & RNA.
5. Separation of protein by SDS PAGE
6. Staining of proteins - Amido black, coomassie brilliant blue & AgNO3.

Developmental Biology

1. Observation of Frog Sperm and Egg – View prepared slides under a microscope.
2. Study of Cleavage Stages – Identify early cell division stages from slides/charts.
3. Blastula and Gastrula Observation – Examine prepared slides to see embryo development.
4. Chick Embryo Development – Observe 24-hour and 48-hour chick embryo slides.
5. Seed Germination – Soak seeds, observe root and shoot emergence.
6. Pollen Germination – Place pollen in sugar solution and observe under a microscope.

Teaching Methodology	Charts, slides, specimens, models and mounting dissection.
Assessment Methodology	Result submission and Viva

Books for Study:

1. Gunasekaran, P. 2009. Laboratory Manual in Microbiology. 1st Edition. New Age International Publishers. Reprint 2009.
2. Delacourt, D 2012. Laboratory Manual for General Microbiology. Lake – Sumter Community College, Leesbug, FL.
3. Brown, A., & Smith, H. (2014). Benson's Microbiological Applications, Laboratory Manual in General Microbiology, Short Version. McGraw-Hill Education.
4. Leboffe, M. J., & Pierce, B. E. (2015). Microbiology: laboratory theory and application. Morton Publishing Company.

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Level (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recognize the methods used for DNA isolation, purification, and quantification.	**K1**
CO2	Describe the process of protein separation and staining using sds page and different dyes.	**K2**
CO3	Identify and explain the key stages in the early development of frog and chick embryos.	**K3**
CO4	Demonstrate the ability to observe and interpret seed and pollen germination processes.	**K4**
CO5	Analyze experimental data and apply developmental biology techniques for scientific research.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25UBT23CP02**			**Core Practical - 2:** Molecular Biology and Developmental Biology						**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
										Mean Overall Score	**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UBT23AC02	**Allied Course - 2:** Bioanalytical Techniques	4	3

Course Objectives
To understand the principles and applications of different types of microscopy and pH measurement techniques.
To explore the fundamentals of spectroscopy and spectrophotometry for biochemical analysis.
To study the principles and techniques of chromatography and electrophoresis for molecular separation.
To analyze the concepts of radioactivity, tracer techniques, and imaging methods.
To examine the principles of centrifugation and its applications in biological sciences.

UNIT I **(12 Hours)**

Microscopy and pH Measurement: Types and principles of Light, Bright and dark field, Fluorescence, Confocal, and Electron Microscopy. pH measurement, buffer preparation, and electrode types.

UNIT II **(12 Hours)**

Spectroscopy and Spectrophotometry: Beer-Lambert's Law, Colorimeter, UV-Visible Spectrophotometer. Advanced spectroscopy: FTIR, AAS, NMR, Raman and Mass Spectrometry.

UNIT III **(12 Hours)**

Chromatography and Electrophoresis: Principles and types of Chromatography: TLC, Ion-Exchange, Affinity, GC, GLC and HPLC. Electrophoresis techniques: Agarose, SDS-PAGE, Iso-electric Focusing.

UNIT IV **(12 Hours)**

Radioactivity and Imaging Techniques: Radioisotopes, Geiger-Muller Counter, Scintillation Counter, and Autoradiography. Imaging techniques: X-ray, NMR, and their applications.

UNIT V **(12 Hours)**

Centrifugation and Imaging Techniques: Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuges – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.

Teaching Methodology	Chart, PPT, Chalk and talk, Models and Field Visit
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Upadhyay and Upadhyay Nath. (2009). "Biophysical Chemistry", Principles and Techniques. Himalaya Publishing House.
2. L. Veerakumari, (2006) "Bioinstrumentation" MJP publishers, Kindle Edition.
3. Skoog D. A. F. James Holler and Stanky, R. Crouch, (2007) "Instrumental Methods of Analysis" Cengage Learning.

Books for Reference:

1. Palanivelu P, 2000. Analytical Biochemistry & Separation Techniques, 4th edition, Twenty first century publications. Prakash M, 2009. Understanding Bioinstrumentation, 1st edition, Discovery Publishing House Pvt Ltd
2. Keith Wilson, John Walker, (2010). Principles and techniques of Biochemistry and Molecular Biology" (7th edition). Cambridge University Press.
3. David L. Nelson, Michael M Cox. Lehninger (2008)." Principles of Biochemistry", Fifth edition W. H. Freeman, Newyork. 3 Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).

Websites and eLearning Sources:

1. https://nptel.ac.in/courses/102103044
2. https://kamarajcollege.ac.in/wp-content/uploads/Allied-I-Bioinstrumentation.pdf
3. https://www.youtube.com/watch?v=MvkFWmzFqNM

4. https://www.nature.com/scitable/definition/gel-electrophoresis-286/ 5. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in- inorganic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in- methodsof-purification-of-organic-compounds/a/principles-of-chromatography

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recall the principles and types of microscopy, pH measurement, and buffer preparation.	**K1**
CO2	Explain the working principles of spectroscopy and spectrophotometry techniques.	**K2**
CO3	Demonstrate the use of chromatography and electrophoresis for biomolecular separation.	**K3**
CO4	Analyze the role of radioactivity and imaging techniques in biological sciences.	**K4**
CO5	Evaluate different types of centrifugation techniques and their applications in research.	**K5**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**				**Hours**				**Credits**	
2	**25UBT23AC02**	**Allied Course - 2:** Bioanalytical Techniques				**4**				**3**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	2	2	2	2	2	3	2	**2.2**
CO2	2	3	2	1	2	2	3	2	2	3	**2.2**
CO3	2	2	3	2	1	2	3	2	2	2	**2.1**
CO4	1	2	2	2	2	2	3	2	3	2	**2.1**
CO5	1	2	2	3	2	2	3	2	2	3	**2.2**
Mean Overall Score											**2.16 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UBT23AP02	**Allied Practical - 2:** Bioanalytical Techniques	2	1

Course Objectives
To understand the preparation and role of buffers in biological systems.
To measure the pH of biological samples using a pH meter.
To estimate DNA and protein concentrations using UV spectrophotometry.
To perform chromatographic techniques for the separation of biomolecules.
To apply electrophoresis techniques for the separation of DNA and proteins.

1. Preparation of Buffer (Phosphate Buffer)
2. Determination of pH of biological samples using pH meter
3. Estimation of DNA and proteins by UV spectrophotometer.
4. Chromatographic analysis of sugar, amino acids, lipids by paper chromatography.
5. Chromatographic analysis of sugar, amino acids, lipids by Thin layer chromatography.
6. Separation of chlorophyll pigments by column chromatography technique.
7. Separation of DNA by Agarose Gel Electrophoresis (AGE)
8. Separation of protein by SDS PAGE

Teaching Methodology	Demonstrations, hands-on practicals, charts, models, specimens.
Assessment Methodology	Observation, Result submission and Viva

Books for Study:

1. Upadhyay and Upadhyay Nath (2009). *Biophysical Chemistry: Principles and Techniques*. Himalaya Publishing House.
2. David L. Nelson & Michael M. Cox (2021). *Lehninger Principles of Biochemistry*. W.H. Freeman & Co.
3. S.K. Sawhney & Randhir Singh (2005). *Introductory Practical Biochemistry*. Narosa Publishing House.
4. Keith Wilson & John Walker (2018). *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University Press.
5. U. Satyanarayana (2021). *Biochemistry*. Elsevier.

Books for Reference:

1. Rodney F. Boyer (2019). *Modern Experimental Biochemistry*. Pearson.
2. Robert K. Scopes (1994). *Protein Purification: Principles and Practice*. Springer.
3. G. Subramanian (2005). *Bioseparations: Principles and Techniques*. Narosa Publishing House.
4. P.D. Sharma (2011). *Microbiology and Plant Pathology*. Rastogi Publications.
5. Gerald Reed (1999). *Enzymes in Food Processing*. Academic Press.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify the principles of buffer preparation and pH measurement techniques.	**K1**
CO2	Describe the use of UV spectrophotometry in the quantification of biomolecules.	**K2**
CO3	Perform chromatographic techniques for the separation of sugars, amino acids, and lipids.	**K3**
CO4	Analyze the separation of biomolecules using electrophoresis techniques.	**K4**
CO5	Interpret the results of chromatography and electrophoresis for biomolecular characterization.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**25UBT23AP02**			**Allied Practical - 2:** Bioanalytical Techniques						**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
Mean Overall Score											**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UHE24AE02	**Ability Enhancement Compulsory Course - 2:** Environmental Studies	2	1

Course Objectives
To enable students connect themselves with nature
To Impart knowledge of the concept of Biodiversity
To create awareness of the causes and consequences of various pollution
To help them recognize the available natural resources and the need to sustain them
To enable them to Identify the environmental problems and offer alternatives by making interventions both individually and collectively

UNIT I: Introduction to Environmental Studies (6 Hours)

Introduction -Subsystems of Earth - Scope and Importance - Various Recycling Methods - Environmental Movements in India – Eco- Feminism - Public awareness - Suggestions to conserve environment

UNIT II: Natural Resources (6 Hours)

Introduction - Food Resources - Land Resources - Forest resources - Mineral Resources - Water Resources - Energy Resources

UNIT III: Ecosystems, Biodiversity and Conservation (6 Hours)

Kinds of Ecosystem - General structure of ecosystem - Functions of Ecosystem - Energy flow and Ecological pyramids - Levels of Biodiversity - Biodiversity at Global Level- Hot spots of Biodiversity - Endangered and Endemic Species - Value of Biodiversity - Threats to Biodiversity - Conservation of Biodiversity

UNIT IV: Environmental Pollution (6 Hours)

Air Pollution - Water Pollution - Oil Pollution - Soil Pollution - Marine Pollution - Noise Pollution - Thermal Pollution - Radiation Pollution

UNIT V: Environmental Organizations and Treatise (6 Hours)

United Nations Environment Program (UNEP) - International treaties on Environmental protection - Ministry of Environment, Forest and Climate Change - Important National Environmental Acts and rules- Environmental Impact assessment

Teaching Methodology	Power point and Field visit
Assessment Methods	Seminar, Group Discussion.

Books for Study:

1. Department of Human Excellence, (2025). *Environmental Studies.*

Books for Reference:

1. Rathor, V.S. & Rathor B. S. (2013). *Management of Natural Resources for Sustainable Development*. Daya Publishing House.
2. Sharma P.D. (2010). *Ecology and Environment*, (8th Ed.). Rastogi Publications.
3. Agrawal, A &Gibson, C.C. (2001). *Introduction: The Role of Community in Natural Resource Conservation.* Rutgers University Press.

Websites and eLearning Sources

1. https://www.unep.org/
2. http://moef.gov.in/en/
3. https://www.ipcc.ch/reports/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Identify the concepts related to global ecology and the environment	**K1**
CO2	Comprehend the natural resources and environmental organizations	**K2**
CO3	Apply the acquired knowledge to sensitize individuals and public about the environmental crisis	**K3**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
2	**25UHE24AE02**		**Ability Enhancement Compulsory Course - 2:** Environmental Studies							**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	1	2	2	3	2	2	2	2	**2.1**
CO2	3	2	1	2	2	3	2	2	2	2	**2.1**
CO3	3	2	2	2	2	2	3	2	1	2	**2.1**
										Mean Overall Score	**2.1 (Medium)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25UHE24VE02	**Value Education - 2:** Fundamentals of Human Rights	2	1

Course Objectives
To sensitize students about various human rights and their importance
To empower them with the right understanding of human rights
To enable them to understand the Fundamental rights and the duties in the constitution of India
To help them comprehend the background, principles and the articles of UDHR
To make them involved in activities to defend human rights

UNIT I: Human Rights - An Introduction (6 Hours)

Introduction- Classification of Human Rights- Scope of Human Rights-Characteristics of Human Rights - Challenges for Human Rights in the 21st Century.

UNIT II: Historical Development of Human Rights (6 Hours)

Human Rights in Pre-World War Era- Human Rights in Post-World War Era- Evolution of International Human Rights Law - the General Assembly Proclamation- Institution Building, Implementation and the Post- Cold War Period. The ICC.

UNIT III: India and Human Rights (6 Hours)

Introduction-Preamble to Indian Constitution - Classification of Fundamental Rights-Salient Features of Fundamental Rights-and Fundamental Duties.

UNIT IV: Human Rights of Women and Children (6 Hours)

Women's Human Rights- Issues related to women's rights - and Rights of Women's and Children

UNIT V: Human Rights Violations and Organizations (6 Hours)

Human Rights Violations - Human Rights Violations in India - the Human Rights Watch Report - Human Rights Organizations - NHRC - SHRC.

Teaching Methodology	Power point, Handouts and Group discussion
Assessment Methods	Seminars, Group Discussion, Assignments.

Books for Study:

1. Department of Human Excellence, (2021). *Techniques of Social Analysis: Fundamentals of Human Rights.*

Books for Reference:

1. Venkatachalem. (2005). The *Constitution of India*, *Giri Law House.*
2. Naik, V. &Shany, M. (2011). *Human rights education and training*, Crescent Publishing Corporation.
3. Neera, B. (2011). *Human Rights Content and Extent.* Swastika Publications.

Websites and eLearning Sources:

1. https://www.un.org/en/universal-declaration-human-rights/
2. https://www.ilo.org/global/lang--en/
3. https://www.amnesty.org/en/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Identify the importance and the values of human rights	**K1**
CO2	Understand the historical background and the development of Human Rights and the related organizations	**K2**
CO3	Apply the provisions of National and International human rights to themselves and the society	**K3**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
2	**25UHE24VE02**	**Value Education - 2:** Fundamentals of Human Rights								**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	1	2	2	3	2	2	2	2	**2.1**
CO2	3	2	1	2	2	3	2	2	2	2	**2.1**
CO3	3	2	2	2	2	2	3	2	1	2	**2.1**
										Mean Overall Score	**2.1 (Medium)**

Semester	Course Code	Title of the Course	Hours/ Week	Credits
3	25UTA31GL03	பொதுத்தமிழ் – 3: General Tamil - 3	4	3

கற்றலின் நோக்கங்கள் (Course Objectives)
சங்க இலக்கியங்களின் இன்றியமையாமையை அறிந்து கொள்ளுதல்
இலக்கியத்தினை நுட்பமாக அறிதலின் வழியாக ஆற்றுப்படுத்தும் திறன் பெறுதல்
இலக்கிய அறநெறிகளைத் தற்கால வாழ்வியலில் பயன்படுத்தும் திறன் பெறுதல்
திணை, துறைகளைப் பகுத்தாராயும் அறிவு பெறுதல்
இலக்கிய இலக்கண நுட்பங்களை வாழ்வியலோடு ஒப்பிடுதல்

அலகு – 1 : **(12 மணி நேரம்)**

குறுந்தொகை: குறிஞ்சித் திணை - பரணர் பாடல் (199), முல்லை - ஔவையார் பாடல் (99), மருதம் - கொல்லிக்கண்ணனார் பாடல் (34), நெய்தல் - கச்சிப்பேட்டு நன்னாகையார் பாடல் (172), பாலை - வெண்பூதி பாடல் (174)

நற்றிணை: குறிஞ்சி - கபிலர் பாடல் (194), முல்லை - இடைக்காடனார் பாடல் (142), மருதம் – உறையூர்க் கதுவாய்ச் சாத்தனார் பாடல் (370), நெய்தல் - அறிவுடைநம்பி பாடல் (15), பாலை - கணக்காயனார் பாடல் (24)

ஐங்குறுநூறு: குறிஞ்சி - அன்னாய் வாழிப் பத்து - அன்னாய் வாழி வேண்டன்னை நம் படப்பை (203), முல்லை - செவிலி கூற்றுப் பத்து - மறியிடைபடுத்த மான்பிணைபோல (401), மருதம் - வேட்கைப் பத்து - வாழி ஆதன் வாழி அவினி (01), நெய்தல் - வெள்ளாங்குருகுப் பத்து - வெள்ளாங் குருகின் பிள்ளை (157), பாலை - உடன்போக்கின் கண் இடைச் சுரத்து உரைத்த பத்து - அறம்புரி அருமறை நவின்ற (387)

புறநானூறு: பிசிராந்தையார் (67), அரிசில் கிழார் (146), காக்கைப்பாடினி (278), அள்ளூர் நன்முல்லையார் (306), பரணர் (352)

அலகு – 2 : **(12 மணி நேரம்)**

சிறுபாணாற்றுப்படை

இலக்கணம் - யாப்பு

அலகு – 3 : **(12 மணி நேரம்)**

கலித்தொகை: குறிஞ்சிக்கலி – திருந்திழாய்! கேளாய் எனத் தொடங்கும் பாடல் (64), முல்லைக்கலி – கண் அகன் இரு விசும்பில் எனத் தொடங்கும் பாடல் (101), மருதக்கலி - நறவினை வரைந்தார்க்கும் எனத் தொடங்கும் பாடல் (98), நெய்தல்கலி - இவர்திமில் எறிதிரை எனத் தொடங்கும் பாடல் (135) பாலைக்கலி - அறனின்றி அயல்தூற்றும் எனத் தொடங்கும் பாடல் (2)

பதிற்றுப்பத்து: குமட்டூர்க் கண்ணனாரின் புண் உமிழ் குருதி (11), பாலைக் கௌதமனாரின் கயிறு குறு முகவை (22)

இலக்கிய வரலாறு: சங்க இலக்கியங்கள், சங்க இலக்கியங்களின் தனித்தன்மைகள்

அலகு – 4 : **(12 மணி நேரம்)**

அகநானூறு: அளிநிலை பொறாது அமரிய முகத்தள் எனத் தொடங்கும் பாடல் (5) , திதலை மாமை தளிர்வனப்பு எனத் தொடங்கும் பாடல் (135), திருந்துஇழை நெகிழ்ந்து எனத் தொடங்கும் பாடல் (387)

தனிப்பாடல் திரட்டு:- பிறவிக் குணமும் பழக்கமும் (196), கொடியது (242), பெரியது (244), அரியது (245), இதுவே நலம் (223)

இலக்கிய வரலாறு: பதினெண்கீழ்க்கணக்கு நூல்கள்

அலகு – 5 : **(12 மணி நேரம்)**

திருக்குறள்: இனியவை கூறல் (10), நட்பு ஆராய்தல் (80)

பழமொழி நானூறு: ஆற்றவும் கற்றார் அறிவுடையார் எனத் தொடங்கும் பாடல் (40), வைத்தனை வைப்பென்று எனத் தொடங்கும் பாடல் (95), உடைப்பெருஞ் செல்வத்து எனத் தொடங்கும் பாடல் (154), தத்தமக்குக் கொண்ட எனத் தொடங்கும் பாடல் (276), நோக்கி அறிகல்லா எனத் தொடங்கும் பாடல் (337)

இனியவை நாற்பது:- முதல் பத்து பாடல்கள் (1-10)

இலக்கணம் - அணி

நாடகம் - விந்தனின் வாழப்பிறந்தவன்

கற்பித்தல் அணுகுமுறை (Teaching Methodology)	**விரிவுரை** (Lecture), **காணொளிக் காட்சி** (Videos), **விளக்கக் காட்சி** (PPT presentation)
மதிப்பீட்டு முறைகள் (Assesment methods)	**கருத்துரை**(Seminar), **குழுக் கலந்துரையாடல்** (Group Discussion), **உடனடித்தேர்வு** (Snap Test), **ஒப்படைவு** (Assignment)

பாடநூல்:

1. பொதுத்தமிழ்-3(2025), தமிழாய்வுத்துறை, தூய வளனார் கல்லூரி

பார்வை நூல்கள்:

1. சுப்பிரமணியன். ச. வே (உ.ஆ.), (2003), சங்க இலக்கியம் , கோவிலூர் மடாலயம்

2. கன்னியப்பன்.சிவ (உ.ஆ.), (2004),தனிப்பாடல் திரட்டு, முல்லை நிலையம்

Websites and eLearning Sources:

- *https://learnsangamtamil.com/*
- *https://www.tamilvu.org/library/*

Course Outcomes		
CO No.	***CO-Statements*** **இப்பாடத்தின் நிறைவில் மாணவர்கள்**	***Cognitive Levels (K-Level)***
CO1	சங்க இலக்கியத்தின் தனித்தன்மைகளை அறிவர்	***K1***
CO2	ஆற்றுப்படை இலக்கியங்களைக் கற்பதன் வழி ஆற்றுப்படுத்தும் முறையை இனங்காண்பர்	***K2***
CO3	இலக்கிய நெறிகளை நடப்பியலில் பயன்படுத்துவர்	***K3***
CO4	திணை துறைகளை நன்கு கற்பதன் வாயிலாகப் பாடல்களைப் பகுப்பாய்வர்	***K4***
CO5	யாப்பு, அணியைக் கற்பதன் வாயிலாகப் புதிய இலக்கிய வடிவங்களைப் படைக்கும் திறன் பெறுவர்.	***K5***

Relationship Matrix												
Semester	***Course Code***			***Title of the Course***							***Hours***	***Credits***
3	***25UTA31GL03***			பொதுத்தமிழ் - *3: General Tamil - 3*							***4***	***3***
Course Outcomes	***Programme Outcomes (POs)***					***Programme Specific Outcomes (PSOs)***					***Mean Score of COs***	
	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PSO1***	***PSO2***	***PSO3***	***PSO4***	***PSO5***		
CO1	*1*	*2*	*2*	*2*	*1*	*3*	*3*	*2*	*3*	*2*	*2.1*	
CO2	*3*	*2*	*1*	*3*	*2*	*3*	*2*	*2*	*3*	*1*	*2.2*	
CO3	*3*	*2*	*1*	*3*	*2*	*3*	*2*	*2*	*3*	*2*	*2.3*	
CO4	*1*	*3*	*2*	*1*	*2*	*3*	*2*	*2*	*2*	*3*	*2.1*	
CO5	*2*	*3*	*2*	*2*	*1*	*3*	*2*	*2*	*2*	*2*	*2.1*	
										Mean Overall Score	***2.16 (High)***	

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UFR31GL03	Language French – 3	4	3

Course Objectives	
1	Remember and Construct Narratives applying the *passé composé* with time indicators to recount past events
2	Understand and express personal memories using the *imparfait* in spoken and written communication to articulate likes, dislikes, and past events.
3	Analyze and interpret different housing options and engage in role-play scenarios to negotiate effectively.
4	Describe physical appearance and personality traits using appropriate adjectives, possessives, and comparatives to describe oneself
5	Evaluate future possibilities in science and communication, expressing hopes and possibilities using the *futur simple* and *conditionnel*

UNIT – I **(12 Hours)**

1. Titre - Nouvelles vies
2. Lexique – Parcours de vie, la vie personnelle, scolaire et professionnelle
3. Grammaire – le passé composé -formation, la phrase négative, les indicateurs de temps
4. Production orale- exprimer son intention de faire quelque chose
5. Production écrite - organiser une activité de loisir

UNIT – II **(12 Hours)**

6. Titre - Je me souviens
7. Lexique – le souvenir : la mémoire, les paysages : à la mer, à la montagne
8. Grammaire – l'imparfait -formation, les pronoms 'y' et 'en', la place de l'adjectif
9. Production orale- exprimer le fait d'aimer et de ne pas aimer
10. Production écrite - raconter un souvenir

UNIT – III **(12 Hours)**

11. Titre - Comme à la maison
12. Lexique – le logement et la location, les frais et les services, le cadre de vie
13. Grammaire – les pronoms relatifs, la comparaison, la condition
14. Production orale- jeu de rôle – louer un logement
15. Production écrite - Décrire un logement

UNIT – IV **(12 Hours)**

16. Titre - Tous pareils, tous différents
17. Lexique – l'apparence physique, les traits de caractère
18. Grammaire – les adjectifs indéfinis, les pronoms possessifs, la comparaison
19. Production orale- faire un compliment
20. Production écrite - faire le portrait physique de quelqu'un

UNIT – V **(12 Hours)**

21. Titre - En route vers le futur
22. Lexique – les sciences et les techniques, les technologies de communication
23. Grammaire – le futur simple, la condition avec 'si', le pronom 'on'
24. Production orale- exprimer un espoir – imaginer à l'avenir
25. Production écrite - Décrire l'utilité d'un objet
26. Indian knowledge system - Analyzing narrative structures in Indian epics vs. French literature by comparing the Mahabharata's moral stories especially the Panchatantra stories to French fables. Practicing French future tense by making simple predictions about personal life by referencing Indian astrology (5%)

Teaching Methodology	Project-Based Chronological Learning (PBL), Digital Media Integration, Genre-Specific Writing Approach, Scenario-based learning (SBL)
Assessment Methods	*Podcast creation:* Students record a short podcast episode on "Childhood Memory". (Rubric – assessed on ability to construct narratives using past tenses and expressing experiences. *Debate:* Debate on "Apartment vs. House: Students must compare housing options, rental costs, and services. (Rubric – evaluated on analytical skills through structured argumentation) *Timeline narrative activity:* Create a timeline about "A Typical College Day" (Rubric – Assessed on the ability to recall and construct a chronological narrative using past) *Letter writing:* Write a letter to a friend describing personal experiences. Write a formal inquiry to a landlord about an apartment (Rubric – Assessed on formal and informal written communication skills)

Books for Study:

1. Fafa, C., Gajdosova, F., Horquin, A., Pasquet, A., Perrard, M., Petitmengin, V., Sperandio, C., Dodin, M., & Veldeman-Abry, J. (2022). *Édito A2: Méthode de français* (2nd ed.). Didier FLE, Hatier. (p.13 – p.77)

Books for Reference:

1. Dauda, P., Giachino, L., &Baracco, C. (2016). *Génération A2*. Didier.
2. Girardet, J., &Pecheur, J. (2017). *Écho A2* (2nd ed.). CLE International

Websites and eLearning Sources:

1. https://www.bbc.co.uk/bitesize/subjects/zc7xpv4
2. https://conjuguemos.com/
3. https://www.busuu.com/en/course/learn-french-online
4. https://www.duolingo.com/learn
5. https://www.newsinslowfrench.com/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	Recall using vocabulary related to personal, academic, and professional life, and compose narratives using the *passé composé* and time indicators.	**K1**
CO2	Express experiences and preferences using *imparfait*to recount memories, express likes and dislikes accurately in spoken and written communication.	**K2**
CO3	Comparedifferent housing options and interpret rental-related expenses and services, and engage in role-play scenarios to negotiate accommodations.	**K3**
CO4	Characterise personal traits by describing physical appearance and personality traits, apply possessive and indefinite adjectives, and formulate comparisons effectively.	**K4**
CO5	Discuss advancements in science and communication, express hopes and possibilities using the *futur simple* and *conditionnel*structures.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
3	**25UFR31GL03**		Language French – 3							**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	1	3	3	3	2.5
CO2	3	2	3	3	1	2	2	2	2	2	2.2
CO3	3	1	3	3	2	2	2	2	1	1	2.0
CO4	2	2	2	2	2	1	2	1	1	1	1.6
CO5	2	3	3	2	2	2	3	3	3	3	2.6
Mean Overall Score											**2.18 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UHI31GL03	Language Hindi - 3	4	3

Course Objectives
To appreciate the features of Modern Hindi Prose
To understand the Hindi literature in association with the contemporary requirements
To enable the students to develop their effective communicative skills in Hindi
To strengthen the language competence among the students
To empower the students with globally employable soft skills

UNIT I **(12 Hours)**

1. Tera Sneh na Khovoom
2. Samband Bodak
3. Reethikal - Namakarn
4. Chitra Varnan (Basic)

UNIT II **(12 Hours)**

5. Paribakshik Shabdavali
6. Smuchaya Bodak
7. Reethikal - Samajik Paristhithiya
8. Vachan Badalo

UNIT III **(12 Hours)**

9. Vismayadi Bodak
10. Reethikal - Sahithyik Paristhithiyam
11. Beerbal ki Chadurai
12. Patra-Patrikao mein Prakashit Gadyansho ka Patan(Basic)

UNIT IV **(12 Hours)**

13. Avikary Shabdh
14. Reethikal - Main Divisions
15. Ling Badalo
16. Karak

UNIT V **(12 Hours)**

17. Reethikal - Visheshathayem
18. Anuvad
19. Bahu Ki Vidha (One Act Play)
20. Bathcheeth - Kaksha mein

Teaching Methodology	Videos, PPT, Quiz, Group Discussion, Case Based Problem Solving
Assessment Methods	Quiz, Seminar, Assignment

Books for Study:

1. Dr. Sanjeev Kumar Jain. (2023). *Anuwad: Siddhant Evam Vyavhar*. Kailash Pustak Sadan.
2. Kamathaprasad Gupth, M. (2021). *Hindi Vyakaran*, Anand Prakashan.
3. Dr. Sadananth Bosalae. (2020). *kavya sarang*. Rajkamal Prakashan.

Books for Reference:

1. Ramdev. (2021). *Vyakaran Pradeep*. Hindi Bhavan.
2. Lakshman Prasad Singh. (2022). *Kavya Ke Sopan*. Bharathy Bhavan Prakashan.
3. Acharya Ramchandra Shukla. (2021). *Hindi Sahitya Ka Itihas*, Prabhat Prakashan.
4. Krishnakumar Gosamy. (2023). *Anuvad vigyan ki Bhumika*. Rajkamal Prakashan.

Websites and eLearning Sources:

1. https://www.hindwi.org/poets/jaishankar-prasad/all
2. https://youtu.be/e9wK-pYfVPc

3. https://www.amarujala.com/kavya/sahitya/sumitranandan-pant-best-hindi-poems
4. https://mycoaching.in/samuchchay-bodhak-kya-hai
5. https://www.subhshiv.in/2021/06/avikari-shabd.html

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of the course, the student will acquire thelisted skills	
CO1	Categorize the poetics in some selective poems.	**K1**
CO2	Practical application of grammar.	**K2**
CO3	Justify the social & political conditions of Riti Kaal in Hindi Literature.	**K3**
CO4	Find out the dialects of Hindi language.	**K4**
CO5	Illustrate the importance given to family ethics by the youth in the modern period according to "Bahoo Ki vidha" One Act play.	**K5**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
3	**25UHI31GL03**	Language Hindi - 3								**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	2	1	3	2	2.4
CO2	3	2	3	2	2	3	2	3	2	3	2.5
CO3	3	2	2	3	1	3	2	3	2	3	2.4
CO4	2	3	3	2	3	2	3	3	2	1	2.4
CO5	3	2	2	3	3	2	1	3	2	3	2.4
Mean Overall Score											**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25USA31GL03	Language Sanskrit - 3	4	3

Course Objectives
To introduce simple poetry in Sanskrit
To give an exposure to the Vedas and Vedangas
To acquaint students with epics and puranas
To train students in conjugation of verbs in future tense
To introduce Upasarga-s and their role in verb formations

UNIT I **(12 Hours)**

Ramodantam, Balakandam (1-15 verses)

UNIT II **(12 Hours)**

Ramodantam, Balakandam (15-30 verses)

UNIT III **(12 Hours)**

Vedas – Vedangas vivaranam

UNIT IV **(12 Hours)**

Asta dasha Purana and Dashopanishads

UNIT V **(12 Hours)**

Upasargas and Bhavishyat Kaalah Vakya Prayoga

Teaching Methodology	Videos, PPT, Blackboard, Demonstration, Exercises
Assessment Methods	Seminar, Quiz, Group Discussion.

Books for Study:

1. VEDIC LITERATURE
2. RAMODANTAM

Books for Reference:

1. Parameshwara, Ramodantam, LIFCO Chennai 2020
2. R.S.Vadhyar & Sons , Book – sellers and publishers , Kalpathu ,Palaghat – 678003 , Kerala , south India , History of Sanskrit Literature 2021
3. Kulapathy , K.M Saral Sanskrit Balabodh , Bharathita vidya bhavan , Munshimarg Mumbai – 400 007 2020

Websites and eLearning Sources:

1. https://www.scribd.com/doc/210917188/Sri-Ramodantam-Sanskrit-Text-With-English-Translation
2. http://www.sushmajee.com/ms-ppp/text/ved-notes.pdf
3. https://occr.org.in/publication/Vedanga.pdf
4. https://www.forgottenbooks.com/en/download/TheThirteenPrincipalUpanishadsTranslatedFromtheSanskrit_10017247.pdf
5. https://www.learnsanskrit.org/guide/uninflected-words/the-upasarga/

Course Outcomes		
CO No.	**CO–Statements**	**Cognitive Levels (K –Levels)**
	On successful completion of this course, students will be able to	
CO1	Remember Characters and events of Ramayana	**K1**
CO2	Understand social ethics and moral duties.	**K2**
CO3	Apply the values learnt, in day-to-day life	**K3**
CO4	Appreciate the Vedic Philosophy	**K4**
CO5	Evaluate and create new words with upasargas	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**25USA31GL03**			Language Sanskrit - 3					**4**		**3**
Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	2	3	3	3	3	3	2	1	2.3
CO2	3	3	2	3	3	2	2	3	3	3	2.7
CO3	3	3	1	3	3	1	1	3	3	3	2.4
CO4	2	2	1	2	3	2	2	3	2	1	2.0
CO5	3	3	2	3	2	2	3	3	3	2	2.6
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
3	25UEN32GE03B	**General English - 3:** English for Science - 1	5	3

Course Objectives
To enable the students to comprehend the local and global issues through the lessons.
To enable the students to do the tasks centering on Skill Development and Grammar.
To empower the students with interactive skills.
To enhance their taste for reading that will naturally develop their vocabulary power and sentence structures
To develop the listening, speaking and writing skills of students through the prescribed texts.

UNIT I: Encounter Between Humans and Aliens (15 Hours)

1. "They're Made Out of Meat" by Terry Bisson
2. Vocabulary in Context: Meat Words
3. Writing: Informal Letter Writing
4. Speaking: Role Play
5. Grammar: Present Perfect Tense

UNIT II: Life After Death (15 Hours)

6. "The Egg" by Andy Weir
7. Vocabulary in Context: Cide Words
8. Writing: Formal Letter Writing
9. Speaking: Description of a Picture
10. Grammar: Present Perfect Continuous Tense

UNIT III: In Communion with Nature (15 Hours)

11. "A Tiger in the House" by Ruskin Bond
12. Vocabulary in Context: Animals and their babies
13. Writing: Job Application Writing (Writing Covering Letter and Curriculum Vitae)
14. Speaking: Description of an Advertisement
15. Grammar: Past Perfect Tense

UNIT IV: Mystery of Venus (15 Hours)

16. "All Summer in a Day" by Ray Bradbury
17. Vocabulary in Context: Rain Words
18. Writing: Drafting Invitation and Brochure
19. Speaking: Short Academic Presentation
20. Grammar; Past Perfect Continuous

UNIT V: Think Before You Trash (15 Hours)

21. "My Frog Recycles All His Trash" by Kenn Nesbitt
22. Vocabulary in Context: Ecological Words
23. Writing: Preparing an Advertisement
24. Speaking: Welcome Address and Vote of Thanks
25. Grammar: Future Perfect Tense and Future Perfect Continuous Tense

* Speaking Components are meant only for internal tests

Teaching Methodology	Lecture, Multimedia Presentations, Discussion and Enacting
Assessment Methods	Speaking, reading, listening and written tests

Books for Study:

1. Francis, V., Dr. D.R. Edwin Christy and Dr. D. Loyola Innaci. *Lingua Science – I,* St. Joseph's College (Autonomous), Tiruchirappalli.

Books for Reference:

1. Wilfred, D. Best. *Students Companion*. HarperCollins Publishers, 2020.

2. Wren & Martin. *Middle School English Grammar and Composition,* S Chand Publishing, 2023.
3. Carnegie, Dale. *The Quick and Easy Way to Effective Speaking*, Rupa Classics, 2013.

Websites and eLearning Sources:

1. https://jerrywbrown.com/wp-content/uploads/2020/02/They-are-made-out-of-meat-Bisson-Terry.pdf
2. https://www.are.na/block/12921440
3. https://pdfcoffee.com/andy-weir-the-egg-pdf-pdf-free.html
4. https://mrsdelcarmen.weebly.com/uploads/3/0/9/0/30908551/a_tiger_in_the_house_by_ruskin_bond.pdf
5. https://poetry4kids.com/poems/my-frog-recycles-all-his-trash/
6. https://www.stcypriansprimaryacademy.co.uk/wp-content/uploads/2021/01/All-Summer-in-a-Day-by-Ray-Bradbury.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Identify and comprehend the local and global issues through the lessons	**K1**
CO2	Use interactive skills	**K2**
CO3	Develop the Listening and Reading Skills of the learners through teacher-led reading practice	**K3**
CO4	Enhance their Listening, Reading, Speaking, and Writing Skills	**K4**
CO5	Develop their Creative and Critical Thinking and Speaking Skills	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**25UEN32GE03B**			**General English - 3:** English for Science - 1						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	2.4
CO2	2	2	3	2	3	3	2	3	2	2	2.3
CO3	2	3	2	3	2	2	3	2	3	2	2.4
CO4	2	2	3	2	3	3	2	3	2	3	2.5
CO5	2	2	2	3	2	2	2	3	2	2	2.2
										Mean Overall Score	**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33CC05	**Core Course - 5:** Gene Technology	4	4

Course Objectives
To understand the fundamental principles and methodologies of recombinant DNA technology.
To explore the various types of vectors used in genetic engineering.
To learn the techniques involved in cloning strategies and gene amplification methods.
To analyze the methods for screening rDNA products and gene sequencing techniques.
To examine the applications of rDNA technology in the development of transgenic plants and animals.

UNIT I **(12 Hours)**

Introduction to rDNA Technology: Basics of genetic engineering and recombinant DNA technology. Isolation of genes, restriction enzymes, DNA polymerase, ligase, and other modifying enzymes.

UNIT II **(12 Hours)**

Vectors: Definition and properties. Plasmids, phage vectors, cosmids, phagemids, viral vectors, shuttle vectors, expression vectors (YAC, BAC), and yeast systems.

UNIT III **(12 Hours)**

Cloning Strategies: Transformation methods- Microinjection, Electroporation, gene gun, $CaCl_2$ mediated and Polyethylene Glycol Mediated. Genomic and cDNA library construction, PCR techniques, DNA fingerprinting, blotting techniques (Southern, Northern, Western), and qPCR.

UNIT IV **(12 Hours)**

Screening & Gene Sequencing: Selection of recombinant DNA using markers, gene sequencing (chemical and automated methods), site-directed mutagenesis, and gene expression analysis.

UNITV **(12 Hours)**

Applications of rDNA Technology: Transgenic plants (pest, stress, and disease resistance), transgenic animals (insulin, farm production), biopharmaceuticals, and secondary metabolite production.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	MCQ, Class test, Seminars, Assignments, Group Discussions

Books for Study:

1. Bernard R. Glick and Cheryl L. Patten (2022) Molecular Biotechnology: Principles and Applications of Recombinant DNA, 6th Edition, ASM Press, Washington DC
2. Robert Brooker (2021) Genetics: Analysis and principles.7th edition, Mc Graw Hill.
3. T. A. Brown (2020). Gene Cloning and DNA Analysis: An Introduction 8th Edition, Wiley Blackwell book
4. Jogdand, S.N, (2019). Gene biotechnology, Fourth edition, Himalaya Publishing House.
5. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. (2018), Lewin's Genes XII, Jones & Bartlett Learning. 6. David Irvine (2018), An Introduction to Genetic Engineering, Syrawood Publishing House

Books for Reference:

1. Vineet Kumar, Muhammad Bilal, Luiz Fernando R. Ferreira, Hafiz M. Iqbal (2023). Genomics Approach to Bioremediation: Principles, Tools, and Emerging Technologies. Wiley-Blackwell book
2. Santosh Kumar Upadhyay, (2021), Genome Engineering for Crop Improvement, Wiley Blackwell book
3. Muhammad Sarwar Khan iqrar Ahmad Khan debmalya Barh, (2016), Applied Molecular Biotechnology the Next Generation of Genetic Engineering, CRC Press, Taylor and Francis Group.

Website and eLearning Sources:

1. https://youtube.be/Yh9w_fyvpUk
2. https://www.bx.psu.edu/~ross/workmg/Isolat_analyz_genes_Chpt3.htm

3. www.biologydiscussion.com/essay/tools-of-recombinant-dna-technology-essay- tools-biotechnology/75954 4.
4. https://youtube.be/D3If9ycpyXM
5. https://bio.libretexts.org/Bookshelves/Biochemistry/Supplemental_Modules_(Biochemis try) /3._Biotechnology_1/3.6%3A_cDNA_and_Genomic_Libraries

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Identify the key principles and techniques in recombinant DNA technology, including the types of vectors and enzymes involved.	**K1**
CO2	Describe various transformation methods and their relevance in gene cloning and expression.	**K2**
CO3	Apply gene amplification techniques, such as PCR, to analyze genetic materials.	**K3**
CO4	Compare screening techniques for recombinant DNA products, including southern, northern, and western blotting.	**K4**
CO5	Assess the impact of recombinant DNA technology in the development of transgenic plants, animals, and biopharmaceuticals.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
3	**25UBT33CC05**		**Core Course - 5:** Gene Technology							**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	3	2	3	2	2	**2.3**
CO2	3	3	3	2	2	3	2	2	2	3	**2.5**
CO3	3	3	3	2	2	3	3	3	2	2	**2.6**
CO4	2	3	3	2	3	2	3	3	3	3	**2.7**
CO5	3	3	3	2	3	3	3	3	3	3	**2.9**
										Mean Overall Score	**2.6 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33CC06	**Core Course - 6:** Immunology	4	3

Course Objectives
To understand the scope, historical background, and biological aspects of immunology.
To explore the classification of immunoglobulins, and the development and activation of T-cells and B-cells.
To comprehend the organs, tissues, and mediators involved in the immune system and lymphocyte circulation.
To learn the mechanisms of different types of immunity, including innate and adaptive immunity.
To investigate immunological techniques, vaccines, transplantation, hypersensitivity reactions, and tumor immunity.

UNIT I **(12 Hours)**

Basics of Immunology: Scope and historical background of immunology, biological aspects of immunology, essential features of antigens (Ag). Classification of immunoglobulins: Types IgG, IgM, IgA, IgD, and IgE (origin, structural functions). Development, maturation, and activation of T-cells and B-cells.

UNIT II **(12 Hours)**

Organs, Tissues, and Mediators of the Immune System: Primary lymphoid organs, secondary lymphoid tissues, lymphocytes, and mediators. Lymphatic system, lymphocyte circulation, and lymphocyte homing.

UNIT III **(12 Hours)**

Types of Immunity: Active and passive immunity, cell-mediated immunity and humoral immunity, natural built-in barriers (skin, semen, saliva, tears, enzymes), complement components, natural killer cells, macrophages, phagocytosis, and pinocytosis. Inflammatory response and mucosal immunity (MALT and GALT).

UNIT IV **(12 Hours)**

Immunological Techniques: Immunodiffusion (one and two-dimensional), single radial immunodiffusion, Ouchterlony immunodiffusion. Immuno-electrophoresis (Rocket immuneelectrophoresis). Agglutination tests: Direct and Indirect, Widal test, ELISA (Principle, methodology, and applications).

UNIT V **(12 Hours)**

Vaccines, Transplantation, Hypersensitivity, and Tumor Immunity: Inactivated, attenuated, recombinant vaccines, peptide, DNA, RNA vaccines (e.g., COVID-19 vaccine), synthetic vaccines, plant-based vaccines. Transplantation: Mechanism, types of grafts, graft rejection, general and specific immunosuppressive therapy, clinical transplantation. Hypersensitivity reactions: Type I and II with examples, autoimmune diseases, tumor types, tumor antigens, causes, and therapy for cancers. Monoclonal antibody production and its applications.

Teaching Methodology	Chart, PPT, Videos, Chalk and talk.
Assessment Methodology	MCQ, Class test, Seminars, Assignments, Group Discussions

Books for Study:

1. A.B. Singh. (2021). *Allergy and Allergen Immunotherapy*. Unknown Binding. Apple Academic Press Inc.; 1st edition.
2. Lauren M. Sompayrac. (2019). *How the Immune System Works*. 6th Edition. Wiley Blackwell.
3. Dr. P. Madhavee Latha. (2018). *A Textbook of Immunology*. S. Chand Publishing.
4. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2017). *Cellular and Molecular Immunology*. 9th Edition. Elsevier.
5. Warren Levinson. (2016). *Review of Medical Microbiology and Immunology*. McGraw-Hill Education.
6. Louis Hawley, Richard J. Ziegler, Benjamin L. Clarke. (2015). *Immunology and Microbiology*. 6th Edition. Lippincott Williams and Wilkins.

Books for Reference:

1. David Male, R. Stokes Pebbles, Victoria Male. (2020). *Immunology*. Elsevier Health Sciences Publishers.
2. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2019). *Basic Immunology*. Elsevier.
3. Jenni Punt, Sharon Stranford, Patricia Jones, Judith Owen. (2018). *Kuby Immunology*. 8th Edition. ML IE PRNT.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. (2017). *Essential Immunology*. 1st Edition. Wiley Blackwell.
5. Kenneth Murphy, Casey Weaver. (2016). *Janeway's Immunobiology*. 9th Edition. Garland Science.

Website and eLearning Sources:

1. https://archive.org/details/cellular-and-molecular-immunology-10th-edition
2. https://www.frontiersin.org/research-topics/463/emerging-immune-functions-of-non hematopoietic-stromal-cells 3.
3. https://assets.cambridge.org/97805217/04892/frontmatter/9780521704892_frontmatter.pdf 4.
4. https://drive.google.com/file/d/18n7FAu3MzWqwUZPblrKWtiA_nBM5STTd/view?pli=1 5.
5. https://www.ncbi.nlm.nih.gov/books/NBK10779/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Identify key concepts in immunology, including the classification of immunoglobulins and the processes of t-cell and b-cell activation.	**K1**
CO2	Discuss the functions and roles of primary and secondary lymphoid organs and describe the process of lymphocyte circulation.	**K2**
CO3	Compare active, passive, cell-mediated, and humoral immunity, highlighting the innate defense mechanisms involved.	**K3**
CO4	Examine and interpret various immunological techniques, including ELISA, agglutination, and immunodiffusion, and their research and diagnostic uses.	**K4**
CO5	Assess the impact of vaccine development, transplantation procedures, hypersensitivity reactions, and tumor immunity on clinical applications.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**25UBT33CC06**			**Core Course - 6:** Immunology					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	2	3	2	2	**2.2**
CO2	3	2	2	1	2	1	3	3	2	3	**2.2**
CO3	1	2	3	2	3	2	3	2	3	2	**2.3**
CO4	2	2	1	3	1	2	3	2	3	3	**2.2**
CO5	1	2	2	2	3	1	3	2	2	3	**2.1**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	25UBT33CP03	**Core Practical - 3:** Gene Technology and Immunology	3	1

Course Objectives
To introduce the techniques for isolating genomic DNA from plant, animal, and bacterial tissues.
To develop skills in protein precipitation and quantification methods, including SDS PAGE and spectrophotometric analysis.
To familiarize students with size analysis of proteins and DNA using SDS PAGE and agarose gel electrophoresis.
To enhance understanding of immunological techniques such as blood group identification, blood cell enumeration, and immune electrophoresis.
To equip students with diagnostic skills in immunology for disease identification using techniques like agglutination tests.

Genetic Engineering and rDNA Technology

1. Isolation of genomic DNA from plant tissue.
2. Isolation of genomic DNA from Animal cells.
3. Isolation of genomic DNA from Bacteria.
4. Isolation of Plasmid DNA.
5. Protein Precipitation.
6. Protein Quantification by Spectrophotometer Method.
7. Size analysis of protein by SDS PAGE.
8. Size analysis of DNA by Agarose Gel Electrophoresis.

Immunology

1. Identification of Cells in a Blood Smear.
2. Blood Cell Counting using Hemocytometer
3. Separation of Serum and Plasma
4. Identification of Blood Group
5. Latex Agglutination Test
6. Single Radial Immunodiffusion
7. Precipitation Reaction – AGD
8. Rocket Immunoelectrophoresis.
9. Testing for Typhoid Antigens - Widal Test

Teaching Methodology	Demonstrations, hands-on practicals, charts, models, specimens.
Assessment Methodology	Observation, Lab Performance Result submission and Viva

Books for Study:

1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2005). *Immunobiology: The Immune System in Health and Disease*. 6th Edition. Garland Science.
2. Peter D. Elias. (2018). *Introduction to Immunology*. 3rd Edition. Academic Press.
3. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). *Basic Immunology: Functions and Disorders of the Immune System*. 5th Edition. Elsevier.
4. Murphy, K., & Weaver, C. (2016). *Janeway's Immunobiology*. 9th Edition. Garland Science.
5. Alan D. & Bruce A. (2017). *Essentials of Immunology*. 2nd Edition. John Wiley & Sons.

Books for Reference:

1. Tharp, M., & Hays, S. (2018). *Immunology: A Short Course*. 8th Edition. Wiley-Blackwell.
2. L. A. M. & Davis, M. (2019). *Cellular Immunology: Principles and Practice*. Elsevier.
3. David J. Talmage. (2021). *Immune System Disorders: Diagnosis, Treatment, and Pathophysiology*. Springer.

Website and E-learning Resources:

1. https://faculty.ksu.edu.sa/sites/default/files/immuno-_lecture-1_0.pdf
2. https://www.academia.edu/23738538/Immunology_Lecture_Notes_Immune_Responses
3. https://archive.nptel.ac.in/courses/102/105/102105083/
4. https://microbenotes.com/category/immunology/
5. https://www.bing.com/videos/riverview/relatedvideo?&q=Immunology+lab+notes&qpvt=Immunology+lab+notes&mid=5EEC54E35D3C5584F7025EEC54E35D3C5584F702&&FORM=VRDGAR

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recognize the techniques used for isolating genomic dna from plants, animals, and bacteria.	**K1**
CO2	Demonstrate protein precipitation and quantification techniques, and analyze protein size using sds page.	**K2**
CO3	Interpret the principles and importance of dna size analysis through agarose gel electrophoresis.	**K3**
CO4	Classify blood groups, count blood cells, and perform immune electrophoresis for diagnostic purposes.	**K4**
CO5	Assess the effectiveness of immunological techniques, such as agglutination tests, in diagnosing viral fevers and understanding disease mechanisms.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**25UBT33CP03**			**Core Practical - 3:** Gene Technology and Immunology					**3**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
Mean Overall Score											**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33AO01A	**Allied Optional – 1:** Enzyme Technology	4	3

Course Objectives
To understand the fundamentals of enzyme structure, classification, and properties.
To explore enzyme kinetics, enzyme-substrate interactions, and factors affecting enzyme activity.
To study enzyme production, purification, and immobilization techniques.
To analyze the applications of enzymes in industrial, medical, and environmental fields.
To evaluate recent advancements and future trends in enzyme technology.

UNIT I **(12 Hours)**

Introduction to Enzyme Technology: Enzyme definition and characteristics, Classification of enzymes (IUB), Enzyme-substrate interaction, Mechanism of enzyme catalysis, Michaelis-Menten equation, Enzyme kinetics, Types of enzyme inhibition (competitive, non-competitive, uncompetitive), Factors affecting enzyme activity (temperature, pH, substrate concentration), Enzyme assay methods, Enzyme purification techniques.

UNIT II **(12 Hours)**

Enzyme Production and Optimization: Sources of industrial enzymes (microbial, plant, animal), Microbial enzyme production, Submerged and solid-state fermentation, medium optimization, Environmental conditions for enzyme production, Genetic strain improvement, Enzyme stabilization techniques (physical, chemical, genetic).

UNIT III **(12 Hours)**

Enzyme Immobilization: Principles of enzyme immobilization, Immobilization methods (adsorption, covalent bonding, encapsulation, cross-linking), Properties of immobilized enzymes, Reusability and stability of immobilized enzymes, Applications of immobilized enzymes.

UNIT IV **(12 Hours)**

Applications of Enzyme Technology: Enzyme applications in the food industry (brewing, dairy, baking, juice clarification), Pharmaceutical applications (diagnostics, antibiotic production, hormone synthesis), Enzymes in environmental biotechnology (waste treatment, bioremediation, biofuels), Enzyme-based biosensors in diagnostics and environmental monitoring.

UNIT V **(12 Hours)**

Recent Trends in Enzyme technology: Recombinant enzyme production, Genetic modification and enzyme enhancement, Directed evolution of enzymes, Enzyme engineering, green chemistry and eco-friendly processes, Nanotechnology in enzyme applications, Challenges in industrial enzyme applications, Future trends in enzyme technology.

Teaching Methodology	Chalk and Talk, PPT, Videos
Assessment Methodology	Seminar, Snap Test, MCQ, Assignments

Books for Study:

1. Trevor Palmer (2018). *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry.* Woodhead Publishing.
2. Nicholas C. Price, Lewis Stevens (2017). *Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins.* Oxford University Press.
3. T. Devasena (2016). *Enzyme Technology.* Oxford University Press.
4. Hans Bisswanger (2014). *Enzyme Kinetics: Principles and Methods.* Wiley-VCH.
5. S. Shanmugam (2012). *Enzyme Technology.* I.K. International Publishing House.Booksfor Reference

Books for Reference:

1. Robert A. Copeland (2017). Evaluation of Enzyme Inhibitors in Drug Discovery. Wiley.

2. John R. Whitaker, Alphons G.J. Voragen, and Dominic W.S. Wong (2014). Handbook of Food Enzymology. CRC Press.
3. N.S. Punekar (2018). Enzymes: Catalysis, Kinetics, and Mechanisms. Springer.

Websites and eLearning Sources:

1. https://www.youtube.com/watch?v=E4JBUvEHov8
2. https://www.youtube.com/watch?v=4DkpZzQbpKA
3. https://www.youtube.com/watch?v=RkXvKjkj2Tg
4. https://www.youtube.com/watch?v=0NRepsBtyLg
5. https://www.youtube.com/watch?v=8M2f4E1kpLs

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-level)**
CO1	Identify the classification, structure, and functions of enzymes.	**K1**
CO2	Describe enzyme kinetics, enzyme-substrate interactions, and factors influencing enzymatic reactions.	**K2**
CO3	Apply various methods of enzyme extraction, purification, and immobilization.	**K3**
CO4	Assess the role of enzymes in biotechnology, pharmaceuticals, and industrial applications.	**K4**
CO5	Critique recent advancements and emerging technologies in enzyme applications.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**25UBT33AO01A**			**Allied Optional - 3:** Enzyme Technology					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	2	3	2	3	1	2	3	2	**2.1**
CO2	3	1	2	2	3	3	2	1	3	2	**2.2**
CO3	2	2	1	3	2	2	1	2	3	2	**2.0**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	3	2	2	3	3	2	3	2	2	3	**2.5**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33AO01B	**Allied Optional – 2:** Drug Discovery and Development	4	3

Course Objectives
To retrieve the major aspects of the drug discovery process, starting with target selection, to compound screening to designing lead candidates.
To discuss and restate the ethical concerns in drug development right from synthesis of drug till the clinical trial of the developed drug.
To implement various drug discovery tools and methods that are used for the identification and design of new drug molecule.
To investigate drugs in detail, their absorption and distribution throughout the body.
To critically analyze and integrate information from the scientific literature.

UNIT I **(12 Hours)**

Introduction to Enzyme Technology: Drugs – definition, source and nature, types of classification and nomenclature, dose response curve and LD50.Role of drugs, Drug – protein interactions, routes of drug administration.

UNIT II **(12 Hours)**

Enzyme Production and Optimization: Drug targets–Therapeutic categories such as vitamins, laxatives, analgesics, Antibiotics, hormones. Enzymes, receptors, carrier proteins. Forces in drug – receptor interaction, Receptor theories.

UNIT III **(12 Hours)**

Drug absorption and metabolism: Pharma cokinetic oriented drug design –Drug solubility and drug stability. Biological testing and bioassays–testing drugs *invitro* and *invivo*. Drug discovery. Lead compounds–natural sources and synthetic sources.

UNIT IV **(12 Hours)**

Applications of Enzyme Technology: Development of Drug and Pharmaceutical Industry: Therapeutic agents, their use and economics; Regulatory aspects. Radioactivity pharma cokinetic action of drugs in human bodies.

UNIT V: **(12 Hours)**

Recent Trends in Enzyme technology: Drug development. Target – oriented drug design, computer aided drug design, Quantitative structure, activity relationship –binding interaction, Functional groups and Pharmacophore. High throughput screening and Molecular docking. Docking softwares – Auto Dock, Hex and Patch Dock. Drug validation softwares – Pre ADMET server.

Teaching Methodology	Chalk and Talk, PPT, Videos
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. BararFSK (2004), Essentials of Pharma co therapeutics, S Chand & Co. Ltd., New Delhi. (Unit I, Unit II and Unit IV).
2. G. Patrick (2013), An Introduction to Medicinal Chemistry, (Ed:5), Oxford Press.

Books for Reference:

1. KristianStromgaard,PovlKrogsgaard-LarsenandUlfMadsen.2016.Textbook of Drug Design and Discovery ,CRC Press.(Unit III)
2. Rebecca Wade and OutiSalo-Ahen.2019. Molecular Modeling in Drug Design. MDPI Press. (Unit V)

Websites and eLearning Sources:

1. https://www.youtube.com/watch?v=E4JBUvEHov8
2. https://www.youtube.com/watch?v=4DkpZzQbpKA

3. https://www.youtube.com/watch?v=RkXvKjkj2Tg
4. https://www.youtube.com/watch?v=0NRepsBtyLg
5. https://www.youtube.com/watch?v=8M2f4E1kpLs

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-level)**
CO1	Identify the classification, structure, and functions of enzymes.	**K1**
CO2	Describe enzyme kinetics, enzyme-substrate interactions, and factors influencing enzymatic reactions.	**K2**
CO3	Apply various methods of enzyme extraction, purification, and immobilization.	**K3**
CO4	Assess the role of enzymes in biotechnology, pharmaceuticals, and industrial applications.	**K4**
CO5	Critique recent advancements and emerging technologies in enzyme applications.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**				**Hours**			**Credits**	
3	**25UBT33AO01B**		**Allied Optional – 2:** Drug Discovery and Development				**4**			**3**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	2	3	2	3	1	3	2	2	**2.1**
CO2	3	1	2	2	3	3	2	1	3	2	**2.2**
CO3	2	2	2	3	2	3	1	2	3	2	**2.0**
CO4	3	3	2	1	2	2	2	2	2	2	**2.1**
CO5	3	2	3	2	3	2	3	2	2	3	**2.5**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33OP01A	**Allied Optional Practical - 1:** Enzyme Technology	2	1

Course Objectives
To understand the fundamental properties, classification, and functions of enzymes.
To explore enzyme kinetics, enzyme-substrate interactions, and factors influencing enzyme activity.
To develop hands-on skills in enzyme extraction, purification, and immobilization techniques.
To investigate the applications of enzymes in various industrial, pharmaceutical, and biotechnological fields.
To analyze recent advancements and innovations in enzyme technology for research and industrial applications.

Enzyme technology

1. Isolation of enzymes from plant, microbial, or animal sources.
2. Precipitation of enzymes using ammonium sulfate or organic solvents.
3. Study of enzyme activity at different pH values.
4. Determination of enzyme stability at various temperatures.
5. Study of substrate specificity using different substrates.
6. Analysis of competitive and non-competitive inhibitors.
7. Entrapment of enzymes in calcium alginate beads.
8. Demonstration of amylase action on starch hydrolysis.
9. Quantification of enzyme concentration using the Lowry or Bradford assay.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Method	Result submission and Viva

Books for Study:

1. Palmer, T. (2007). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd Ed.). Woodhead Publishing.
2. Price, N.C., & Stevens, L. (1999). Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins (3rd Ed.). Oxford University Press.
3. Chaplin, M.F., & Bucke, C. (1990). Enzyme Technology. Cambridge University Press.
4. Whitaker, J.R. (1994). Principles of Enzymology for Food Sciences (2nd Ed.). Marcel Dekker Inc.
5. Dixon, M., & Webb, E.C. (1979). Enzymes (3rd Ed.). Academic Press.

Books for Reference:

1. Nelson, D.L., & Cox, M.M. (2021). Lehninger Principles of Biochemistry (8th Ed.). W.H. Freeman.
2. Voet, D., Voet, J.G., & Pratt, C.W. (2018). Fundamentals of Biochemistry: Life at the Molecular Level (5th Ed.). Wiley.
3. Aehle, W. (2007). Enzymes in Industry: Production and Applications (3rd Ed.). Wiley-VCH.

Website and eLearning Resources:

1. https://www.youtube.com/watch?v=yg5Gueu_F7g
2. https://www.youtube.com/watch?v=0IJXvFyTtOI
3. https://www.youtube.com/watch?v=W50sMQT2yr4
4. https://www.youtube.com/watch?v=vV1caMMyc-M
5. https://www.youtube.com/watch?v=EHUzVi6kKeA

Course Outcomes		
CO No.	**CO-statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Identify the classification, structure, and functions of enzymes.	**K1**
CO2	Describe enzyme kinetics, substrate specificity, and factors affecting enzyme activity.	**K2**
CO3	Apply enzyme extraction, purification, and immobilization methods in laboratory settings.	**K3**
CO4	Examine the role of enzymes in biotechnology, pharmaceuticals, and industrial applications.	**K4**
CO5	Assess recent developments and emerging technologies in enzyme applications.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
3	**25UBT33OP01A**			**Allied Optional Practical - 1:** Enzyme Technology					**2**		**1**
Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	2	3	1	3	**2.4**
CO2	1	2	3	2	3	2	1	2	3	3	**2.2**
CO3	3	2	2	3	2	1	3	3	2	2	**2.3**
CO4	2	3	2	2	1	3	1	2	3	3	**2.2**
CO5	3	3	3	2	3	2	2	1	3	3	**2.5**
										Mean Overall Score	**2.32 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UBT33OP01B	**Allied Optional Practical - 1:** Drug Discovery and Development	2	1

Course Objectives
To introduce students to molecular docking using AutoDock software.
To perform docking of small molecules (ligands) with target proteins and analyze interactions.
To utilize online databases like PubChem for identifying potential drug candidates.
To predict and evaluate protein 3D structures using Swiss-Model**.**
To assess drug-likeness and ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) properties using SwissADME**.**

Drug Discovery and Development

1. Introduction to docking software (AutoDock).
2. Docking of a small molecule (ligand) to a target protein.
3. Analyzing docking scores and interactions.
4. Searching for potential drug candidates using databases (PubChem).
5. Filtering compounds based on Lipinski's Rule of Five.
6. Predicting the 3D structure of a protein using Swiss-Model.
7. Evaluating the quality of the predicted model.
8. Predicting Absorption, Distribution, Metabolism, Excretion, and Toxicity of drug molecules.
9. Using online tools like SwissADME.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Method	Result submission and Viva

Books for Study:

1. Molecular Docking and Molecular Dynamics: From Bench to Bedside – Mohane S. Coumar, 1st Edition, 2021
2. Bioinformatics: Sequence and Genome Analysis – David W. Mount, 2nd Edition, 2004
3. Computational Drug Discovery and Design – Riccardo Baron, 1st Edition, 2021

Books for Reference:

1. Autodock: Computational Drug Discovery – S. Forli & A.J. Olson, 1st Edition, 2012
2. Drug Discovery and Development – Raymond G. Hill & Humphrey P. Rang, 1st Edition, 2012
3. Introduction to Bioinformatics – Arthur M. Lesk, 5th Edition, 2019

Website and eLearning Resources:

1. https://www.youtube.com/watch?v=1K8-kNuDgoY
2. https://www.youtube.com/watch?v=E3hQ3qLzAps
3. https://www.youtube.com/watch?v=ZQvov8zL9zA

Course Outcomes		
CO No.	**CO-statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recall the fundamental concepts of molecular docking and drug discovery.	**K1**
CO2	Understand the principles of ligand-protein interactions and docking methodologies.	**K2**
CO3	Apply docking tools to perform molecular docking and interpret docking results.	**K3**
CO4	Analyze docking scores and filter potential drug candidates using Lipinski's Rule of Five**.**	**K4**
CO5	Evaluate protein structures and assess their quality using Swiss-Model and other computational tools.	**K5**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**							**Hours/Week**		**Credits**
3	**25UBT33OP01B**	**Allied Optional Practical - 1:** Drug Discovery and Development							**2**		**1**
Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	2	3	1	3	**2.4**
CO2	1	2	3	2	3	2	1	2	3	3	**2.2**
CO3	3	2	2	3	2	1	3	3	2	2	**2.3**
CO4	2	3	2	2	1	3	1	2	3	3	**2.2**
CO5	3	3	3	2	3	2	2	1	3	3	**2.5**
										Mean Overall Score	**2.32 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UHE34VE03A	**Value Education - 3:** Social Ethics - 1	2	1

Course Objectives
To gain a comprehensive understanding of the principles advocated in social ethics.
To examine the different types of political systems in a thorough manner.
To comprehend the role and obligations of the educated youth.
To evaluate the conduct of the elected representatives in a detailed manner.
To thoughtfully analyze the various forms of cyber-crime.

UNIT I: Introduction to Social Ethics (6 Hours)

Social ethics, social ethics and social responsibility, social ethics play an important role on the areas, religion influences social changes and vice versa, secularism. Social ethics and corporate dynamics, forms of social ethics.

UNIT II: The Economic and Political System of Today (6 Hours)

Planned economy and communism - market economy and capitalism- socialism - mixed economy -the emerging market economy - political system- totalitarian system- oligarchic system.

UNIT III: Integrity in Public Life National Integration (6 Hours)

What is Integrity, Public Life, Integrity and Public Life, Integrity in a Democratic State, India as Democratic State, Behavior of a elected representative of India, Noticeable degradation acts of elected Representatives, Suggestions to stem this rot, Types of integrity, Transparency can be a guarantee for integrity.

UNIT IV: Cyber Crime (6 Hours)

Business Ethics, Business ethics permeates the whole organization, measuring business ethics, The Vital factors highlighting the importance of business ethics, Cyber-crime, Strategies in committing Cyber Crimes, Factors aiding Cyber Crime, computer Hacking, Cyber Bullying, Telecommunications piracy, Counter Measures to Cyber Crime, Ethical Hacking.

UNIT V: Social Integration (6 Hours)

Global challenges, the future is with the Educational Youth, Cost of the Sacrifice, Crusaders against corruption, Responsibility of the Educated Youth, Positive Global Scenario, right to Education, Eradicating gender inequality, Sustainable Human Development, Social Integration, Elimination Crime, Integration with Global Market

Teaching Methodology	Lecture, PPT, Power point
Assessment Methods	Online Test, Group Discussions

Books for Study:

1. Department of Human Excellence. (2021). *Formation of Youth*, St Joseph's College (Autonomous), Tiruchirappalli.

Books for Reference:

1. Arora, R.K. (2014). *Ethics, Integrity and Values*. Public Service Paperback.
2. Cunningham, D. (2004). *There's something happening here: The new left, the Klan, and FBI counterintelligence*. Berkeley: University of California Press.
3. Mali, P. (2017). *Cyber law & Cyber Crimes simplified*. Cyber Info Media Paperback.
4. Richardson, M. (2019). *Cyber Crime: Law and Practice Hardcover - Import*.

Websites and eLearning Sources:

1. https://cybercrime.gov.in/
2. https://open.lib.umn.edu/sociology/chapter/14-2-types-of-political-systems/
3. https://www.esv.org/resources/esv-global-study-bible/social-ethics/
4. https://en.wikipedia.org/wiki/Political_system

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Know the responsibility of the educated youth.	**K1**
CO2	Understand the values prescribed under social ethics.	**K2**
CO3	Apply their minds critically to the various types of cyber-crime.	**K3**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours/Week**		**Credits**
3	**25UHE34VE03A**		**Value Education - 3:** Social Ethics - 1						**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	2	3	3	**2.7**
CO2	3	2	2	2	3	2	2	3	2	2	**2.3**
CO3	2	3	3	3	2	3	3	3	3	3	**2.8**
										Mean Overall Score	**2.6 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25UHE34VE03B	**Value Education - 3:** Religious Doctrine - 1	2	1

Course Objectives
To impart knowledge to students about Salvation History
To familiarize students with the life and mission of Jesus Christ
To help Students understand the Holy Spirit
To empower students on Gospel Values
To equip the students about Mother Mary

UNIT I **(6 Hours)**

God of salvation

UNIT II **(6 Hours)**

Life & Mission of Jesus Christ

UNIT III **(6 Hours)**

The Holy Spirit

UNIT IV **(6 Hours)**

Gospel Values

UNIT V **(6 Hours)**

Mary, the mother of God

Teaching Methodology	Power point, Assignment and Group discussion
Assessment Methods	Online Test, Group Discussions

Books for Study:

1. Department of Human Excellence. (2022). *Fullness of Life.* St. Joseph's College, Tiruchirappalli.

Books for Reference:

1. (1994). *Compendium: Catechism of the Catholic Church.* Bengaluru: Theological Publications in India.
2. Holy Bible (NRSV).

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Understand the Salvation History	**K1**
CO2	Grasp to the life and purpose of Jesus Christ	**K2**
CO3	Live out the teachings of the Gospel	**K3**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours/Week**		**Credits**
3	**25UHE34VE03B**		**Value Education - 3:** Religious Doctrine - 1						**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	2	3	3	**2.7**
CO2	3	2	2	2	3	3	3	3	2	2	**2.5**
CO3	2	2	3	3	2	2	3	3	3	3	**2.6**
										Mean Overall Score	**2.6 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25USS34SE01	**Skill Enhancement Course - 1:** Soft Skills	2	1

Course Objectives
To help students understand, practice, and improve their communication skills
To enable students with effective presentation skills
To help students attend interviews confidently and participate effectively in group discussions
To make students realise their potential and excel on personal as well as professional grounds
To develop the thinking skills of students for better performance in competitive exams, interviews and u discussions

UNIT I Communication Skills (6 Hours)

Basics of Communication: Importance of Good Communication Skills, Types of Communication Skills, Verbal Communication, Non-verbal Communication, Tips for Improving Nonverbal Communication, Communication Styles, Barriers to Communication, Ways To Improve Communication Skills, Practicum. *Professional Grooming*: How to Create the Impact for that First Impression, Presentation Skills, Developing Handouts, Developing Notes, Adding Visual and Audio Effects, Practicum

UNIT II Resume Writing & Interview Skills (6 Hours)

*Resume Writing***:** The Purpose of a Resume, Finding a Job & Making a Career, Length of Resume, Order of Resume, Tailoring the Resume, What your Resume should include, Some Tips for Listing a Bachelor's degree on Your Resume, What NOT to put on your Resume, Formatting Resume, Difference between Resume, Biodata and Curriculum Vitae, Preparation of a Resume *Interview Skills***:** Meaning of Interview, Types of Interviews, How to get ready for the big day?, Appropriate Attire, Etiquette, Mastering the Art of Meet and Greet, Resume - Points to Remember, Practicum *Group Discussion:* Why is GD Essential?, Factors that influence GD, Outcome of GD, Tips for participation in a GD, Useful phrases for GD, Success Tips in GD, Practicum.

UNIT III Personal Effectiveness (6 Hours)

Self-Discovery: Characteristics of Personality, Kinds of Self, Who am I?, Personality Inventory Table *Goal Setting*: Why do Goal Setting?, Goal Setting Process, Smart Goals

UNIT IV Numerical Ability (6 Hours)

Average, Simple Interest, Compound Interest, Profit and Loss, Area, Volume and Surface Area

UNIT V (6 Hours)

Verbal Reasoning: Series Completion, Analogy. *Non-Verbal Reasoning*.

Teaching Methodology	Chart, PPT, chalk and talk, Video Presentation

Books for Study:

1. Balaiah, J., & Joy, J. L. (2024). Straight from the Traits: Securing Soft Skills, (Revised 3rd Ed.). St. Joseph's College, Tiruchirappalli.

Books for Reference:

1. Aggarwal, R.S. (2010). A Modern Approach to Verbal and Non-Verbal Reasoning, S. Chand.
2. Balaiah, J. & Joy, J. L. (2018). Winners in the Making: A primer on soft skills. St. Joseph's College, Tiruchirappalli.
3. Covey S. R. (2004). The 7 Habits of Highly Effective People: Restoring the Character Ethic (Rev. ed.). Free Press.
4. Egan, G. (1994). The Skilled Helper (5th Ed.). Pacific Grove, Brooks/Cole.
5. Khera, S. (2014). You Can Win. Macmillan Books.
6. Martin, Y. (2005). Hiring the Best: A Manager 's Guide to Effective Interviewing and Recruiting, (5th Ed.). Adams Media.
7. Sankaran, K., & Kumar, M. (2010). Group Discussion and Public Speaking, (5th Ed.). M.I. Publishers.
8. Trishna. (2012). How to do well in GDS & Interviews, (3rd Ed.). Pearson Education.

Websites and eLearning Sources:

1. https://www.indeed.com/career-advice/resumes-cover-letters/communication-skills
2. https://www.seek.com.au/career-advice/article/50-communication-skills-for-the-workplace-your-resume
3. https://southeast.iu.edu/career/files/power-phrases.pdf
4. https://dese.ade.arkansas.gov/Files/20201209124449_Professional-Communication.docx
5. https://www.dol.gov/sites/dolgov/files/ETA/publications/00-wes.pdf
6. https://www.tmu.ac.in/other_websites/cdoe.tmu.ac.in.old/study-material/28-08-2024/COMMON/SEMESTER_2/MAIN_SOFT_SKILLS.pdf
7. https://byjus.com/maths/profit-and-loss-questions/
8. https://www.indiabix.com/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Analyse problems directed at testing their cognitive abilities	**K1**
CO2	Present the best of themselves as job seekers and communicate effectively in all contexts	**K2**
CO3	Assess themselves, set goals, and manage conflicts that are expected of a good leader	**K3**
CO4	Enhance numerical ability required for the employees for various transactions	**K4**
CO5	Develop aptitude skills required by the employers	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
3	**25USS34SE01**		**Skill Enhancement Course - 1:** Soft Skills						**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	2	2	2	3	2	3	2.5
CO2	2	3	3	2	3	3	2	3	2	2	2.5
CO3	2	2	3	3	2	3	3	3	2	2	2.5
CO4	2	2	3	3	2	3	3	3	2	2	2.5
CO5	2	2	3	3	2	3	3	3	2	2	2.5
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
4	25UTA41GL04B	General Tamil – 4: அறிவியல் தமிழ் (Scientific Tamil)	4	3

கற்றலின் நோக்கங்கள் (Course Objectives)
அன்றாட வாழ்வில் அறிவியலின் செல்வாக்கை அறிந்துகொள்ளுதல்
பண்டைத்தமிழர் வாழ்வில் இடம்பெற்ற அறிவியல்கூறுகளைக் கண்டறிதல்
திரைப்படம், நூல் போன்றவற்றைத் திறனாய்வு நோக்கில் ஆராய்தல்
தமிழர்தம் பண்பாடும் அறிவியலும் கொண்ட தொடர்பைப் புலப்படுத்துதல்
படைப்பாற்றல் திறனைக் கண்டறிந்து அறிவியல் படைப்புகளை உருவாக்கல்

அலகு - 1 **(12 மணி நேரம்)**

கணிதவியல்: பார்ப்பார்க்கு அல்லது பணிபு அறியலையே(பதிற்றுப்பத்து : 63) - விசும்பில் ஊழி - ஊழ்-ஊழ் செல்லக் (பரிபாடல் : திருமால் : 4-15) - கண்ணுங்கால் கண்ணும் கணிதமே (சிறுபஞ்சமூலம் :92) - உண்ணாது வைக்கும் பெரும்பொருள் (இன்னா நாற்பது -16)

உயிரியல்: தொல்காப்பியம் : மரபியல் : (27-33) - சிறுவீ ஞாழல் (நற்றிணை 195) - நீடுவெயில் உழந்த (அகநானூறு 335) - வள் இதழ் ஒண் செங்காந்தள் (குறிஞ்சிப்பாட்டு 61-98) -வாள்வரி வயமான் (அகநானூறு 99) -புல்லாகிப் பூடாய்ப் புழுவாய் மரமாகிப் (திருவாசகம்- சிவபுராணம் 26-32

உரைநடைக்கட்டுரை: வியக்க வைக்கும் தமிழரின் அறிவியல்

பயன்முறை கற்றல்: வலைப்பூக்கள் உருவாக்கம்- அறிவியல்கலைச்சொல்லாக்கம்

அலகு - 2 **(12 மணி நேரம்)**

நீரியல்: அம்ம வாழி தோழி (குறுந்தொகை 287) -அம்ம வாழி, தோழி கைம்மிக (அகம் 141: 1-11) -முழங்கு முந்நீர் முழுவதும் வளைஇப் (புறநானூறு-18) -வீங்கு விளிம்பு உரீஇய விசை அமை நோன் சிலை (அகநானூறு-175) -விசும்பு ஆடு பறவை வீழ் பதிப் படர (குறிஞ்சிப்பாட்டு 46-53)- **திருக்குறள்** வான்சிறப்பு - **பதார்த்த சிந்தாமணி :** குளத்து சலந்தானே கொடிதான (27) - ஏரிசலம் வாதமிகு மதுவே (31) -அருவிநீர் மேக மகற்நுங் (39)

ஆழிப்பேரலை: வாழ்க எம் கோ மன்னவர் (சிலப்பதிகாரம் -காடுகாண் காதை15-22)- தீங்கனி நாவல் ஓங்கும்இத் தீவிடை (மணிமேகலை-பீடிகை கண்டு பிறப்புணரந்த காதை (17-22)

உரைநடைக்கட்டுரை: தமிழர்களின் மருத்துவ அறிவியல்

புதினம்: இரா.நடராசன் : சர்க்கஸ்.காம்

அலகு - 3 **(12 மணி நேரம்)**

உலகியல்: நிலம் தீ நீர் வளி விசும்போடு (தொல்.பொருள் 635) - நிலம் நீர் வளி விசும்பு என்ற நான்கின் (பதிற்று 14:1-4) - மண் திணித்த நிலனும் (புறம் 2 1-6)

வானியல்: செஞ்ஞா யிற்றுச் செலவும் (புறம் 30 1-7) - ஆடு இயல் அழல் குட்டத்து புறநானூறு (229) - நெடுவயின் ஒளிறு மின்னுப் பரந்தாங்கு (பதிற்று 24:1-26)

உரைநடைக்கட்டுரை: தமிழ் இலக்கியங்களில் வெளிப்படும் நீர் மேலாண்மையியல்

பயன்முறை கற்றல்: நூல் – திறனாய்வு

அலகு - 4 **(12 மணி நேரம்)**

மருத்துவம்: திருக்குறள்: மருந்து - இரும்பனம் புடையல் ஈகை வான்கழல் (பதிற்றுப்பத்து -42) – ஏற்றி இறக்கி இருகாலும் பூரிக்கும் – (திருமந்திரம் 571) - இல்லையே வாதம் எழில்நடை கோழியாம் (கர்ப்ப வாகடத் திரட்டு-23)

அணு இயற்பியல்: மணிமேகலை : சமயக் கணக்கர் தந்திறங் கேட்ட காதை (105-165) - மேவிய சீவன் வடிவது சொல்லிடில் (திருமந்திரம் –ஏழாம் தந்திரம் 29:1) - அணுவில் அணுவினை ஆதிபிரானை (திருமந்திரம் –ஏழாம் தந்திரம் 28:2) - அண்டப் பகுதியின் உண்டைப் பிறக்கம் (திருவாசகம்- திருவண்டப் பகுதி 106) - அண்டங்கள் எல்லாம் அணுவாக (திருவிளையாடல் புராணம் –அணுவியல் (பாயிரம்-6) - செகத்தையெல்லாம் அணுவளவுஞ் சிதறா வண்ணஞ் (தாயுமானவர் – தந்தை தாய் 6)

உரைநடைக்கட்டுரை: தமிழில் அறிவியல் புனைவுகள்

பயன்முறை கற்றல்: திரைப்படத் திறனாய்வு- ஆவணப் படத்திறனாய்வு

அலகு - 5 **(12 மணி நேரம்)**

கட்டடவியல்: வானம் ஊன்றிய மதலை போல (பெரும்பாண் : 346-351) - விரி கதிர் பரப்பிய வியல் வாய் மண்டிலம் (நெடுநல்வாடை 72-88) - காடுகொன்று நாடாக்கி (பட்டினப்பாலை 283-288) - பெருக்காறு சடைக்கணிந்த பெருமான் சேரும் (தேவாரம் 2801)

பகுத்தறிவியல்: ஓசை உள்ள கல்லை (சிவவாக்கியர் -412)- நட்டகல்லைத் தெய்வமென்று (சிவவாக்கியர்-482)

உரைநடைக்கட்டுரை: அறிவியல் தமிழின் வளர்ச்சி நிலைகள்;

பயன்முறை கற்றல்: பழமொழிகளில் அறிவியல், மூலிகைகளைக் கண்டறிதல்

கற்பித்தல் அணுகுமுறை *(Teaching Methodology)*	விரிவுரை ***(Lecture),*** காணொளிக் காட்சி ***(Videos),*** விளக்கக் காட்சி ***(PPT presentation)***
மதிப்பீட்டு முறைகள் *(Assesment methods)*	வலைப்பூ உருவாக்கம், திரைப்படத் திறனாய்வு, மூலிகை சேகரிப்பு, நூல் திறனாய்வு

பாட நூல்கள்:

1. தமிழாய்வுத்துறை (2025), அறிவியல் தமிழ், தூய வளனார் தன்னாட்சிக் கல்லூரி
2. இரா.நடராசன்; (2010), சர்க்கஸ்.காம், Books for Children
3. மூர்த்தி அ.கி. (2001), அறிவியல் கலைச்சொல் அகராதி, மணிவாசகர் பதிப்பகம்.

பார்வை நூல்கள்:

1. அரிமாப்பாமகன் .ஆ (2017), சங்க இலக்கியத்தில் சூழலியல், இராசகுணா பதிப்பகம்
2. குழந்தைசாமி.வா.செ., (2001), அறிவியல்தமிழ், பாரதி பதிப்பகம்

Websites and eLearning Sources:

- https://www.tamilcomputingjournal.org/?page_id=2622
- https://archive.org/details/dli.jZY9lup2kZl6TuXGlZQdjZl3lMyy
- https://thamizhiyal.com/?p=2775
- https://www.valaitamil.com/jan-month-Article_19160.html

Course Outcomes

CO No	***CO–Statements*** **இப்பாடத்தின் நிறைவில் மாணவர்கள்**	***Cognitive Levels (K –Levels)***
CO -1	அன்றாட வாழ்வில் அறிவியலின் செல்வாக்கை அறிந்துகொள்வர்	***K1***
CO -2	பண்டைத்தமிழர் வாழ்வில் இடம்பெற்ற அறிவியல்கூறுகளைக் கண்டறிவர்	***K2***
CO -3	திரைப்படம், நூல் போன்றவற்றைத் திறனாய்வு நோக்கில் ஆராய்வர்	***K3***
CO -4	தமிழர்தம் பண்பாடும் அறிவியலும் கொண்ட தொடர்பைப் புலப்படுத்துவர்	***K4***
CO -5	படைப்பாற்றல் திறனைக் கண்டறிந்து அறிவியல் படைப்புகளை உருவாக்கும் திறன் பெறுவர்	***K5***

Relationship Matrix											
Semester	***Course Code***			***Title of the Course***						***Hours***	***Credits***
4	***25UTA41GL04B***			*General Tamil – 4:* அறிவியல் தமிழ் *(Scientific Tamil)*						***4***	***3***
Course Outcomes↓	***Programme Outcomes (PO)***					***Programme Specific Outcomes (PSO)***					***Mean Scores of COs***
	PO-1	***PO-2***	***PO-3***	***PO-4***	***PO-5***	***PSO-1***	***PSO-2***	***PSO-3***	***PSO-4***	***PSO-5***	
CO-1	*3*	*2*	*3*	*2*	*2*	*3*	*3*	*2*	*2*	*2*	*2.4*
CO-2	*2*	*3*	*3*	*2*	*3*	*2*	*3*	*2*	*3*	*2*	*2.5*
CO-3	*3*	*2*	*2*	*3*	*3*	*3*	*2*	*3*	*3*	*3*	*2.7*
CO-4	*2*	*3*	*3*	*2*	*2*	*3*	*2*	*3*	*3*	*2*	*2.5*
CO-5	*3*	*1*	*2*	*3*	*2*	*2*	*3*	*2*	*3*	*3*	*2.4*
										Mean Overall Score	***2.5 (High)***

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UFR41GL04	Language French – 4	4	3

Course Objectives
Express preferences and opinions with precision using quantity expressions, and pronouns to convey satisfaction or dissatisfaction.
Describe Health Conditions and provide medical advice using appropriate grammatical structures to engage in meaningful discussions
Communicate Effectively in Social and Professional Settings by expressing desires and requests and using polite expressions
Exchange Travel Information and construct well-structured narratives to recount journeys
Enhance communication through structured language with contextually appropriate statements across various topics

UNIT – I **(12 Hours)**

1. Titre - En cuisine
2. Lexique – les aliments, la restauration, les goûts et les sensations
3. Grammaire – les quantités et le pronom ‘en’, la restriction ‘ne…que’, l’obligation
4. Production orale- communiquer au restaurant
5. Production écrite - exprimer sa satisfaction et son insatisfaction

UNIT – II **(12 Hours)**

6. Titre - A votre sante
7. Lexique – les corps et la sante, la médecine et les urgences
8. Grammaire – les pronoms COD et COI, le superlatif, les pronoms interrogatifs
9. Production orale- parler des problèmes de santé
10. Production écrite - Donner un conseil pour une condition médicale

UNIT – III **(12 Hours)**

11. Titre - Dans les médias
12. Lexique – les médias audios et les réseaux sociaux
13. Grammaire – la cause et la conséquence, le subjonctif, la place des pronoms
14. Production orale- exprimer son intérêt et sa préférence
15. Production écrite - faire une critique positive et négative

UNIT – IV **(12 Hours)**

16. Titre - Consommer responsable
17. Lexique – la consommation, les catégories de produits, le travail manuel
18. Grammaire – le conditionnel présent – formation et emploi, le gérondif
19. Production orale- demander et proposer un service
20. Production écrite - exprimer un souhait ou un désir

UNIT – V **(12 Hours)**

1. Titre - Envies d’ailleurs
2. Lexique – le voyage, l’hébergement, le séjour, le tourisme
3. Grammaire – le passé composé et l’imparfait dans le récit, les pronoms démonstratifs
4. Production orale- demander des renseignements sur un voyage
5. Production écrite - parler d’une visite touristique
6. Indian knowledge system - Writing travel narratives based on ancient Indian pilgrimage sites and comparing with French monuments. Using French quantity expressions and pronouns to describe Ayurvedic food portions and dietary balance and offering Ayurvedic-based medical advice. (5%)

Teaching Methodology	L'approche communicative (Communicative Language Teaching -CLT), Genre-Based Approach, Experimental learning, Flipped Classroom Approach
Assessment Methods	*Role-Play:* Restaurant Experience: waiter and customer ordering food and expressing opinions on the meal. (Rubric – graded on usage of expressions related to food and grammatical accuracy) *Written assessment:* Write a short critique of a social media platform, movie, or advertisement. (Rubric – assessed on ability to express opinions and logical argumentation) *Travel Blog or Postcard Writing:* Write a blog post or postcard describing a recent travel experience, using descriptive language (Rubric – assessed on structured narrative writing in a travel context and usage of past tenses) *Group Debate:* Media & Society: Debate the impact of social media on education. (Rubric – graded on critical thinking, Argument clarity and participation

Books for Study:

1. Fafa, C., Gajdosova, F., Horquin, A., Pasquet, A., Perrard, M., Petitmengin, V., Sperandio, C., Dodin, M., &Veldeman-Abry, J. (2022).*Édito A2: Méthode de français* (2nd ed.). Didier FLE, Hatier. (p.83 – p.152)

Books for Reference:

1. Dauda, P., Giachino, L., & Baracco, C. (2016).*Génération A2*. Didier.
2. Girardet, J., &Pecheur, J. (2017). *Écho A2* (2nd ed.). CLE International

Websites and eLearning Sources:

1. https://cuisine-facile.com/
2. https://www.france.fr/en/
3. https://www.sncf-connect.com/
4. https://www.routard.com/
5. https://sante.lefigaro.fr/

Course Outcomes		
CO No.	**CO–Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K –Levels)**
CO1	Apply vocabulary related to food by using quantity expressions and pronoun to communicate satisfaction or dissatisfaction in oral and written contexts.	**K1**
CO2	Identify and describe health conditions, construct superlative forms, and formulate medical advice using appropriate grammatical structures.	**K2**
CO3	Express opinions, preferences, and critiques about various media platforms, apply cause-and-consequence structures	**K3**
CO4	Utilize vocabulary related to consumption, express desires and requests effectively in professional and social interactions.	**K4**
CO5	Request and provide travel-related information and describe tourist experiences using demonstrative pronouns and structured narratives.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UFR41GL04**			Language French – 4					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	1	2	2	1	3	2	1	2	2	1.8
CO2	2	2	2	3	1	2	2	2	2	2	2.0
CO3	2	3	2	3	3	2	2	3	1	1	2.2
CO4	3	3	3	2	3	3	1	2	2	2	2.4
CO5	3	2	2	3	2	2	2	1	1	2	2.0
Mean Overall Score											**2.08 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**25UHI41GL04**	Language Hindi - 4	**4**	**3**

Course Objectives
To strengthen the language competence among the students
To equip students with cinematic perspective by comparative studies of Hindi literature
To enable the students to develop their effective communicative skills in Hindi
To strengthen the language competence among the students
To incept research-oriented aspirations among students

UNIT I **(12 Hours)**

1. Prathyay
2. Char Bhai
3. Adhunik Kaal - Introduction
4. Adhunik Kal – Namakarn

UNIT II **(12 Hours)**

5. Chitra Varnan(Advanced)
6. Paryayvachy Shabdh
7. Bathcheeth - Hotel mein
8. Adhunik Kal - Samajik Paristhithiyam

UNIT III **(12 Hours)**

9. Upasarg
10. Thulsi ke Dhoe
11. Apathit Gadyansh
12. Adhunik Kal – Sahithyakar

UNIT IV **(12 Hours)**

13. Review- Book/Film
14. Paryavaran Pradookshan
15. Adhunik Kal - Main Divisions
16. Anuvad

UNIT V **(12 Hours)**

17. Kaal
18. Patra-Patrikao mein Prakashit Gadyansho ka Patan (Advanced)
19. Sapnom Kee Home Delivery (Novel)
20. Adhunik Kal - Visheshathayem

Teaching Methodology	Debate Participation, Videos, PPT, Quiz, Project Work
Assessment Methods	Quiz, Snap Test, Group Discussion

Books for Study:

1. Dr. Sadananth Bosalae. (2022). *kavya sarang*. Rajkamal Prakashan.
2. Kamathaprasad Gupth, M. (2021). *Hindi Vyakaran*. Anand Prakashan.
3. Dr. Sanjeev Kumar Jain. (2022). *Anuwad: Siddhant Evam Vyavhar.* Kailash Pustak Sadan.

Books for Reference:

1. Rajeswar Prasad Chaturvedi. (2021). *Hindi vyakarana*. Upakar Prakashan.
2. Ramdev. (2021). *Vyakaran Pradeep*. Hindi Bhavan.
3. Krishnakumar Gosamy. (2023). *Anuvad vigyan ki Bhumika*. Rajkamal Prakashan.
4. Acharya Ramchandra Shukla. (2021). *Hindi Sahitya Ka Itihas*, Prabhat Prakashan.
5. Mamta Kaliya. (2022). *Sapno Ki Home Delivery.* Lokbharti Prakashan.

Websites and eLearning Sources:

1. https://youtu.be/xmr-DaQ3LhA
2. https://mycoaching.in/adhunik-kaal
3. https://m.sahityakunj.net/entries/view/bhartiya-sahitya-mein-anuvad-kee-bhoomika
4. https://mycoaching.in/upsarg-in-hindi
5. https://kalingaliteraryfestival.com/speakers/mamta-kalia/

Course Outcomes		
CO No.	**CO–Statements** On successful completion of the course, the student will acquire the listed skills.	**Cognitive Levels (K –Levels)**
CO1	List out the social conditions prevailed in Modern Period which are depicted in Hindi Literature.	**K1**
CO2	Discuss the dialects of Hindi language.	**K2**
CO3	Illustrate the works of some eminent Hindi Writers related to society.	**K3**
CO4	Evaluate the film & Literary works in Hindi.	**K4**
CO5	Analyze the human values expressed in life and literature of Hindi Novelist “Mamatha Kaliya”.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours / week**		**Credits**
4	**25UHI41GL04**			Language Hindi – 4					**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	2	3	1	2.4
CO2	3	2	3	3	2	3	2	3	1	2	2.4
CO3	3	2	2	3	2	2	1	3	2	3	2.3
CO4	3	2	3	1	3	3	2	3	3	2	2.5
CO5	3	2	2	3	3	2	3	2	3	3	2.6
									Mean Overall Score		**2.44 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25USA41GL04	Language Sanskrit - 4	4	3

Course Objectives
To give an exposure to Sanskrit drama in general
To showcase the structure of pre-kalidasan plays in Sanskrit
To coach students in Sanskrit morphology
To acquaint students with the structures of Sanskrit syntax
To impart communicative skills in Sanskrit by training in the functional aspects of the language

UNIT I **(12 Hours)**

Samskrita Vyavahara sahasri vakiya Prayogaha

UNIT II **(12 Hours)**

Lot Lakaarah, Prayaogh Kartari Vaakyaani

UNIT III **(12 Hours)**

Naatakasya Itihaasah Vivaranam, Thuva and Tum Suffixs

UNIT IV **(12 Hours)**

Karnabhaaram, Naatakasya Visistyam

UNIT V **(12 Hours)**

Samskrita Racanani Vubhavoga

Teaching Methodology	Videos, PPT, Blackboard, Demonstration, Exercises
Assessment Methods	Seminar, Quiz, Group Discussion.

Books for Study:

1. Karnabhavam & Literature Language
2. Dhaatu Manjari
3. Samskrita Vyavahara Sahasri (A Collection of One Thousand Sentances),Samskrita Bharati, Delhi,2021

Books for Reference:

1. R. S. Vadhyar & Sons , Book – sellers and publishers , Kalpathu ,Palghat – 678003 , Kerala , south India , History of Sanskrit Literature 2021
2. Kulapathy , K.M Saral Sanskrit Balabodh , Bharathita vidya bhavan , Munshimarg Mumbai – 400 007 2020
3. Samskrita Bharathi , Aksharam 8 th cross , 2nd phase Giri nagar Bangalore Vadatu sanskritam – Samaskara Binduhu 2021

Websites and eLearning Sources:

1. https://sanskritdocuments.org/doc_z_misc_major_works/daily.pdf
2. https://www.learnsanskrit.org/guide/verbs-1/karmani-and-bhave-prayoga/
3. https://ia902903.us.archive.org/7/items/in.ernet.dli.2015.102820/2015.102820.The-Sanskrit-Drama-In-Its-Origin-Development-Theory-And-Practice.pdf
4. https://archive.org/details/oafI_karna-bharam-karnas-burden-of-bhasa-with-dr.-sudhakar-malaviya-gokuldas-sanskrit
5. https://sanskritwisdom.com/composition/essays/sanskrit-language/

Course Outcomes		
CO No.	**CO–Statements**	**Cognitive Levels (K –Levels)**
	On successful completion of this course, students will be able to	
CO1	Understand human behaviors by studying dramas	**K1**
CO2	Remember and identifying Mahabharata characters and events	**K2**
CO3	Apply the morals learnt in day-to-day life	**K3**
CO4	Appreciate ancient Sanskrit dramas	**K4**
CO5	Create new conversational sentences and to Improve self-character (Personality Development)	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**25USA41GL04**			Language Sanskrit - 4						**4**	**3**
Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	3	3	3	3	2	2.4
CO2	2	2	3	3	2	3	2	3	3	2	2.5
CO3	3	3	2	3	2	1	1	3	3	3	2.4
CO4	2	2	3	2	3	3	3	3	2	3	2.6
CO5	2	3	3	3	2	1	3	3	3	2	2.5
Mean Overall Score											**2.48 (High)**

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
4	25UEN42GE04B	**General English - 4:** English for Science - 2	5	3

Course Objectives
To expand vocabulary by learning and using context-specific words.
To improve writing through practice in reports, reviews, and social media posts.
To master grammar by focusing on question tags and subject-verb agreement.
To enhance speaking skills through debates and discussions.
To appreciate literature and science to boost creative thinking.

UNIT I: Simple Ways to Explore Nature **(15 Hours)**

1. "Marie Curie Biographical" Taken from The Nobel Prize
2. Vocabulary in Context: Radioactive Elements
3. Writing: Media Reports
4. Speaking: Expansion of a Proverb
5. Grammar: Question Tag

UNIT II: The Limits of Human Knowledge **(15 Hours)**

1. "The Marry Month of May" by O. Henry
2. Vocabulary in Context: Seasonal Words
3. Writing: Book or Film Review
4. Speaking: Debate
5. Grammar: WH Questions

UNIT III: Difference Between Original and Copy **(15 Hours)**

1. "The story of Dolly the sheep" taken from Natural World, Science and Technology, Scotland
2. Vocabulary in Context: Cloning Words
3. Writing: E-mail Etiquette
4. Speaking: Group Discussion
5. Grammar: Yes or No Questions

UNIT IV: The Other Worlds **(15 Hours)**

1. "The Star" by Arthur C. Clarke
2. Vocabulary in Context: Astronomical Words
3. Writing: Writing for Social Media (Blogs, Twitter, Instagram and Facebook)
4. Speaking: Story Telling
5. Grammar: Conditional Sentences

UNIT V: Scientific Temparament **(15 Hours)**

1. "The Particle Dance" by Emily Dickinson
2. Vocabulary in Context: Scientific Instruments
3. Writing: Creating Digital Profile
4. Speaking: Spin a Yarn
5. Grammar: Subject Verb Agreement

* Speaking Components are meant only for internal tests

Teaching Methodology	Lecture, Multimedia Presentations, Discussion and Enacting
Assessment Tools	Speaking, reading, listening and written tests

Books for Study:

1. Francis, V., Dr. D.R. Edwin Christy and Dr. D. Loyola Innaci. *Lingua Science – II,* St. Joseph's College (Autonomous), Tiruchirappalli.

Books for Reference:

1. Wilfred, D. Best. *Students Companion*. Harper Collins Publishers, 2020.
2. Dickinson, Emily. *The Complete Poems of Emily Dickinson*, Back Bay Books, 1973.

Websites and eLearning Sources:

1. https://www.nobelprize.org/prizes/physics/1903/marie-curie/biographical/
2. https://www.gutenberg.org/files/59637/59637-h/59637-h.htm
3. https://www.nms.ac.uk/discover-catalogue/the-story-of-dolly-the-sheep
4. https://sites.uni.edu/morgans/astro/course/TheStar.pdf
5. https://poemverse.org/short-poems-about-science/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify and comprehend the local and global issues through the lessons	**K1, K2**
CO2	Use interactive skills	**K3**
CO3	Develop the Listening and Reading Skills of the learners through teacher-led reading practice	**K6**
CO4	Improve their General Writing Skills such as Note-Taking, Note- Making Précis Writing, Paragraph Writing, and Writing Short Essays on Current	**K6**
CO5	Develop their Creative and Critical Thinking and Speaking Skills	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**25UEN42GE04B**			**General English - 4:** English for Science - 2						**5**	**3**
Course Outcome (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	2.4
CO2	2	2	3	2	3	3	2	3	2	2	2.3
CO3	2	3	2	3	2	2	3	2	3	2	2.4
CO4	2	2	3	2	3	3	2	3	2	3	2.5
CO5	2	2	2	3	2	2	2	3	2	2	2.2
										Mean Overall Score	**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43CC07	**Core Course - 7:** Bioprocess Technology	4	3

Course Objectives
To understand the basic principles of biochemical engineering and microbial growth kinetics.
To describe the types of fermentation processes, including solid-state and submerged fermentation, and their applications.
To demonstrate knowledge of upstream processing techniques such as media formulation, sterilization, and scale-up processes.
To analyze various downstream processing methods including bioseparation techniques, cell disruption, and purification strategies.
To evaluate the role of microbes in food processing, production, and preservation.

UNIT I **(12 Hours)**

Fundamentals of Bioprocess Technology: Introduction and History of Fermentation, Isolation, screening, and maintenance of industrially important microbes, microbial growth and death kinetics in industrial processes, strain improvement strategies for enhanced yield and desirable characteristics.

UNIT II **(12 Hours)**

Bioreactor types and fermentation processes: Solid-state and submerged fermentation, batch, fed-batch, and continuous fermentation, conventional fermentation vs. biotransformation, fermentation media and economics, fermenter design, types of fermenters – stirred tank, continuous reactors, air-driven column reactors, bubble column, and airlift reactors.

UNIT III **(12 Hours)**

Media formulation and Bioprocess parameters: Media formulation and sterilization, aeration and agitation principles, measurement and control of bioprocess parameters, scale-up and scale-down techniques in industrial fermentation.

UNIT IV **(12 Hours)**

Bioseparation techniques: Filtration, centrifugation, sedimentation, flocculation, microfiltration, and sonication, cell disruption methods – enzymatic lysis and liquid-liquid extraction, purification – precipitation (ammonium sulfate, solvents), electrophoresis, and crystallization, extraction techniques – solvent, aqueous two-phase, supercritical, chromatographic purification, reverse osmosis, ultrafiltration, drying, crystallization, storage, and packaging.

UNIT V **(12 Hours)**

Microbial Applications in Food Processing and Production: Fermented foods and beverages, food ingredients and additives from fermentation, microbial roles in food preservation, microbes in pickling, color and flavor production, alcoholic beverages, and other industrial products, bioconversion of food waste (whey, molasses, starch) into valuable products, production and applications of bacteriocins from lactic acid bacteria in food preservation.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. B. L. R. Subramanian (2019). Bioprocess Engineering Principles. Elsevier Science.
2. Shuler, M. L., & Kargi, F. (2002). Bioprocess Engineering: Basic Concepts. Prentice Hall.
3. James M. Lee (1992). Microbial Engineering. Springer.
4. L. E. Cardillo & S. G. Haug (2016). Food Bioprocessing Technologies. CRC Press.
5. S. S. P. Rao, C. D. Leong, and K. S. N. Murthy (2020). Bioprocess Engineering and Applications in Food Industries. Springer.

Books for Reference:

1. L. D. V. Singh (2015). *Fundamentals of Biochemical Engineering.* Wiley India.
2. D. Patel, R. K. Cheryan, and H. U. M. El-Ansary (2017). *Downstream Processing in Biotechnology.* CRC Press.
3. D. D. L. Arora (2018). *Fermentation and Biochemical Engineering Handbook.* Marcel Dekker.

Websites and eLearning Sources:

1. https://www.youtube.com/watch?v=sRtLm7Yg3eI
2. https://www.youtube.com/watch?v=KHw0gRxeRGs
3. https://www.youtube.com/watch?v=pVwFltr7fWI
4. https://www.youtube.com/watch?v=KduIiHcA3Uk
5. https://www.youtube.com/watch?v=lOegQbbx-Lw

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Recall the principles of microbial growth kinetics, fermentation processes, and upstream/downstream processing techniques.	**K1**
CO2	Describe the differences between solid-state and submerged fermentation, and explain the roles of microbes in food processing.	**K2**
CO3	Apply fermentation techniques to industrial-scale bioprocesses, and use bioseparation methods in downstream processing.	**K3**
CO4	Analyze fermentation economics and the design of bioreactors for specific applications, and evaluate the effectiveness of different downstream processing methods.	**K4**
CO5	Critically assess the role of microbes in food production and bioconversion, and evaluate the overall bioprocess from upstream to downstream processing for industrial applications.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
4	**25UBT43CC07**		**Core Course - 7:** Bioprocess Technology						**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	2	2	**2.3**
CO2	2	3	2	3	3	2	3	2	2	2	**2.4**
CO3	2	2	3	2	3	3	3	2	3	3	**2.7**
CO4	3	3	2	1	2	3	2	3	1	2	**2.3**
CO5	2	3	2	2	3	2	3	2	2	3	**2.6**
										Mean Overall Score	**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43CC08	**Core Course - 8:** Bioinformatics (Internship Embedded Course)	4	4

Course Objectives
To introduce the foundational concepts and terminology of Bioinformatics and its evolution as a field.
To explain the tools used in Bioinformatics, including biological databases, sequence alignment, and analysis techniques.
To demonstrate the application of sequence analysis and structure prediction in genomics and proteomics.
To explore the drug discovery process and the role of Bioinformatics in molecular docking and high throughput screening.
To evaluate the applications of Bioinformatics in various fields such as genomics, proteomics, molecular medicine, and drug development.

UNIT I **(12 Hours)**

Basic Introduction to Bioinformatics: History of Bioinformatics, Introduction to concepts and terminology of Internet, Search Engines, Databases, Software.

UNIT II **(12 Hours)**

Tools in Bioinformatics: Review of basics about structure of macromolecules (DNA, RNA, and Proteins), Online resources for Bioinformatics, Biological Databases (NCBI, Genbank, EMBL, Swissprot, PDB), Executing search and retrieval of data, Sequence alignment, Multiple sequence alignment, pairwise alignment using BLAST.

UNIT III **(12 Hours)**

Sequence Analysis and Alignment: Bioinformatics in genomics and proteomics, Gene sequencing tools (Traditional methods like Maxam and Gilbert's method, Sanger's sequencing), Structure prediction tools, Gene and protein expression analysis, Similarity search databases (FASTA), Phylogeny analysis, Phylogenetic tree construction, Computational analysis tools (SCHRODINGER), and Visualization tools (RASMOL).

UNIT IV **(12 Hours)**

Drug Designing - History of drug discovery, Steps in drug design, Role of molecular docking in drug design, Introduction to simulation software in biology, High throughput screening, AutoDock, ChemDraw, ADMET, PubMed, and MEDLINE.

UNIT V **(12 Hours)**

Applications of Bioinformatics: Applications of Bioinformatics in Genomics, Proteomics, Molecular medicine, Drug development, Forensic analysis, Evolutionary studies, Crop improvement, and Environmental monitoring. Emerging areas in Bioinformatics.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. D. R. Brown (2019). Bioinformatics: A Biologist's Guide to Biostatistics and Data Analysis. Wiley.
2. D. W. Mount (2004). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.
3. S. J. Palmer (2015). Introduction to Bioinformatics. Wiley-Blackwell.
4. T. A. Jain (2016). Bioinformatics: Methods and Applications. PHI Learning Pvt. Ltd.
5. S. J. R. Ellison (2019). Bioinformatics: A Practical Guide to Analysis of Genes and Proteins. Elsevier.

Books for Reference:

1. J. S. F. Berman, H. H. Buzan, and D. A. Boeckmann (2018). Bioinformatics: Databases and Algorithms. Springer.
   A. D. Baxevanis and B. F. Francis (2011). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley.
2. P. P. Sharma (2017). Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases, and Analytical Tools. Academic Press. Natarajan, V., & Krishna, D. (2019). *Bioinformatics: Methods and Protocols*. Springer.

Websites and eLearning Sources:

1. https://www.youtube.com/watch?v=b7tC0B9d8LQ
2. https://www.youtube.com/watch?v=G9pzw8ht8zI
3. https://www.youtube.com/watch?v=LPQLt5goxLU
4. https://www.youtube.com/watch?v=VY7uQU4Jb14
5. https://www.youtube.com/watch?v=m7kD3yAV1Lg

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify the history of bioinformatics, key concepts of the internet, search engines, databases, and bioinformatics software.	**K1**
CO2	Describe the function of biological databases (NCBI, GENBANK, EMBL, SWISSPROT, PDB) and explain how to retrieve data and use sequence alignment techniques such as blast.	**K2**
CO3	Utilize sequence alignment methods like pairwise and multiple sequence alignment, and carry out data retrieval using online bioinformatics tools and resources.	**K3**
CO4	Evaluate gene sequencing methods (sanger's sequencing, maxam and gilbert's method) and structure prediction tools to analyze gene and protein expression.	**K4**
CO5	Assess the significance of bioinformatics in drug discovery, including the processes of molecular docking, high throughput screening, and its impact across fields like molecular medicine, genomics, and drug development.	**K5**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
4	**25UBT43CC08**	**Core Course - 8:** Bioinformatics (Internship Embedded Course)								**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	2	3	2	3	2	3	2	**2.2**
CO2	2	3	2	2	1	3	2	2	2	2	**2.1**
CO3	2	3	1	3	3	3	2	3	2	2	**2.4**
CO4	2	2	2	2	3	3	2	3	2	2	**2.3**
CO5	2	2	2	2	3	3	2	2	2	2	**2.2**
										Mean Overall Score	**1.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43CP04	**Core Practical - 4:** Bioprocess Technology	3	1

Course Objectives
To understand the principles and methods of isolating and cultivating industrially relevant microorganisms.
To demonstrate techniques for studying microbial growth, media preparation, and the effect of environmental factors like pH and temperature on growth.
To analyze the production of microbial products, such as enzymes or organic acids, and evaluate enzyme activity through assays.
To explore bioinformatics tools and databases for retrieving nucleotide and protein sequences and analyzing them using various alignment and modeling techniques.
To apply bioinformatics tools for sequence analysis, phylogenetic tree construction, and molecular visualization.

Bioprocess Technology

1. Isolate industrially relevant microbes from different environments.
2. Study the growth of microorganisms under controlled lab conditions (using growth curves).
3. Measure microbial growth by optical density (OD) or colony-forming unit (CFU) counts.
4. Prepare different types of growth media for microbial cultivation.
5. Study the effect of pH and temperature on microbial growth.
6. Set up fermentation with solid materials, such as using wheat or rice bran as substrates.
7. Extract microbial products such as enzymes or organic acids using filtration or centrifugation.
8. Conduct assays to measure enzyme activity (e.g., amylase, protease) produced by microbes.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Methodology	Observation, Result submission and Viva

Books for Study:

1. Shuler, M. L., & Kargi, F. (2017). *Bioprocess Engineering: Basic Concepts*. Pearson Education.
2. Stanbury, P. F., & Whitaker, A. (2016). *Principles of Fermentation Technology*. Elsevier.
3. Nakanishi, K. (2018). *Bioprocess Engineering: Kinetics, Modeling, and Control*. Wiley.
4. Baxevanis, A. D., & Ouellette, B. F. (2019). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. Wiley.
5. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor Laboratory Press.
6. Lesk, A. M. (2019). *Introduction to Bioinformatics*. Oxford University Press.

Books for Reference:

1. Alberts, B. (2015). *Molecular Biology of the Cell*. Garland Science.
2. Bioinformatics for Dummies (2018). Wiley.
3. Natarajan, V., & Krishna, D. (2019). *Bioinformatics: Methods and Protocols*. Springer.

YouTube Links:

1. Bioinformatics Basics | Introduction to Bioinformatics | Learn Bioinformatics
2. Bioinformatics - Sequence Alignment, BLAST and Multiple Sequence Alignment
3. Bioinformatics Tutorial: How to use GenBank, Uniprot, EMBL, and NCBI databases
4. Bioinformatics Tools for Sequence Analysis and Phylogenetic Tree Construction
5. How to use PyMOL for Protein Visualization | Bioinformatics Tutorial

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	List key bioinformatics databases like GENBANK, EMBL, and UNIPROT for sequence retrieval.	**K1**
CO2	Describe the various bioinformatics tools used for sequence analysis, including blast and CLUSTALW.	**K2**
CO3	Use online bioinformatics databases to retrieve nucleotide and protein sequences and perform pairwise and multiple sequence alignments.	**K3**
CO4	Construct phylogenetic trees based on sequence alignments and analyze protein structures using molecular visualization tools like RASMOL.	**K4**
CO5	Evaluate the role of microbial growth conditions in optimizing production processes in bioprocess technology.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
4	**25UBT43CP04**		**Core Practical - 4:** Bioprocess Technology							**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	2	3	2	3	2	3	2	**2.2**
CO2	2	3	2	2	1	3	2	2	2	2	**2.1**
CO3	2	3	1	3	3	3	2	3	2	2	**2.4**
CO4	2	2	2	2	3	3	2	3	2	2	**2.3**
CO5	2	2	2	2	3	3	2	2	2	2	**2.2**
Mean Overall Score											**2.0 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43AO02A	**Allied Optional – 2:** Molecular Genetics	4	3

Course Objectives
To introduce the historical developments and fundamental concepts of molecular biology and genetics.
To explain the structure and functions of nucleic acids, chromosomes, and genetic variation.
To explore Mendelian inheritance, sex-linked traits, and the principles of genetic mapping.
To analyze sex determination mechanisms and the role of genetic linkage in inheritance.
To apply the principles of developmental genetics and population genetics to real-world examples.

UNIT I **(12 Hours)**

History of Molecular Biology and Genetics: The history of molecular biology and genetics, including key experiments that showed DNA is the genetic material. These include Griffith's experiment, Hershey-Chase experiment, and Avery-Macleod-McCarty experiment. The structure and functions of nucleic acids like nucleosides, nucleotides, purines, and pyrimidines. The model of DNA by Watson and Crick and the different forms of DNA: A, B, and Z. The structure and types of RNA.

UNIT II **(12 Hours)**

Chromosomes and Genetic Variation: How chromosomes are structured, including chromatin and chromatids. Special types of chromosomes like polytene and lampbrush chromosomes. Changes in chromosome number and structure, and chromosomal disorders. Transposable elements in both prokaryotes and eukaryotes.

UNIT III **(12 Hours)**

Basic Genetics and Inheritance: Mendel's laws of inheritance, including the Law of Dominance, Uniformity, Incomplete Dominance, and Codominance. The Law of Segregation of genes and Morgan's experiments with Drosophila. The Law of Independent Assortment and how to perform dihybrid crosses, test crosses, and back crosses.

UNIT IV **(12 Hours)**

Sex Determination and Genetic Linkage: Sex is determination and differentiation, and sex-linked inheritance. Sex-influenced and sex-limited traits. Linkage analysis in fruit flies, recombination, and how to map genes in eukaryotes. Understanding multiple alleles like the ABO blood group system.

UNIT V **(12 Hours)**

Developmental Genetics and Population Genetics: Genes control development in organisms like Drosophila and Arabidopsis. The basics of population genetics, including gene frequency and the factors that affect it. Genetic drift and shift, and how to analyze family trees (pedigree analysis)
for genetic counselling.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Vishnu Shankar, S. (2021). Fundamentals of Genetics and Molecular Biology. Red'shine Publication Pvt. Ltd.
2. Pierce, B. A. (2018). Genetics essentials: concepts and connections (p. 488). WH Freeman.
3. Brown, T. A. (2012). Introduction to genetics: a molecular approach. Garland Science.
4. Vega, L. (2019). Fundamentals of genetics. Scientific e-Resources.
5. Panchal, S. (2022). Fundamentals of Genetics. In Genetics Fundamentals Notes (pp. 3-51). Singapore: Springer Nature Singapore.

Books for Reference:

1. Pierce, B. A. (2012). Genetics: a conceptual approach. Macmillan.
2. Brooker, R. J. (2015). Genetics: analysis and principles. (No Title).
3. Goldberg, M. L., Fischer, J. A., Hood, L., & Hartwell, L. (2021). Genetics: from genes to genomes. (No Title).

4. Russell, P. J., & Gordey, K. (2002). I Genetics (No. QH430 R87). San Francisco: Benjamin Cummings.
5. Watson, J. D. (2004). Molecular biology of the gene. Pearson Education India.

Websites and E-Learning Sources:

1. https://www.youtube.com/watch?v=ekd47VdlJXs
2. https://www.youtube.com/watch?v=8kK2zwjRV0M
3. https://www.youtube.com/watch?v=F9wIh8PfmWs
4. https://www.youtube.com/watch?v=knpdsH4qN6I
5. https://www.youtube.com/watch?v=81Tc9ErVv0k

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recall key experiments that proved DNA is the genetic material, including Griffith's, Hershey-Chase, and Avery-MacLeod-McCarty experiments.	**K1**
CO2	Explain the significance of different forms of DNA (A, B, Z) and the structure of RNA.	**K2**
CO3	Apply Mendel's laws to solve problems related to inheritance, including dihybrid crosses, test crosses, and back crosses.	**K3**
CO4	Investigate the genetic basis of sex-linked inheritance and sex-influenced traits.	**K4**
CO5	Evaluate the impact of genetic drift and shift on gene frequency in populations.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UBT43AO02A**			**Allied Optional – 2:** Molecular Genetics					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	2	3	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	2	1	2	3	2	3	1	2	3	2	**2.1**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43AO02B	**Allied Optional – 2:** Biodiversity and Conservation	4	3

Course Objectives
To identify different levels of biodiversity and their significance.
To analyze threats to biodiversity using case studies.
To apply in-situ and ex-situ conservation techniques.
To evaluate the role of traditional knowledge in biodiversity conservation.
To demonstrate knowledge of biodiversity laws and policies.

UNIT I **(12 Hours)**

Introduction to Biodiversity: Definition, levels of biodiversity (genetic, species, and ecosystem diversity), significance of biodiversity, global and Indian biodiversity hotspots, megadiversity countries, and endemism, diversity of Indian medicinal plants.

UNIT II **(12 Hours)**

Threats to Biodiversity: Causes of biodiversity loss—habitat destruction, pollution, climate change, invasive species, overexploitation, and human activities. Endangered and extinct species, IUCN Red List categories, and case studies on species extinction.

UNIT III **(12 Hours)**

Conservation Strategies: In-situ conservation methods (national parks, wildlife sanctuaries, biosphere reserves) and ex-situ conservation methods (botanical gardens, seed banks, gene banks, and zoos). Role of organizations like National Biodiversity Conservation (NBA) and its role in conservation, IUCN, UNEP, WWF, and CBD in conservation efforts.

UNIT IV **(12 Hours)**

Sustainable Use of Biodiversity: Ecotourism, biodiversity and agriculture, traditional knowledge and its importance, bioprospecting, and biopiracy. Role of communities in conservation, sacred groves, and sustainable development goals (SDGs) related to biodiversity.

UNIT V **(12 Hours)**

Biodiversity Laws and Policies: National and international biodiversity conservation laws and treaties—Wildlife Protection Act (1972), Biological Diversity Act (2002), CITES, Ramsar Convention, and Convention on Biological Diversity (CBD). Role of government and NGOs in biodiversity conservation.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Biodiversity – E.O. Wilson (2003), National Academy Press.
2. Conservation Biology: Foundations, Concepts, Applications – Fred Van Dyke & Rachel L. Lamb (2020), Springer.
3. Principles of Conservation Biology – Martha J. Groom, Gary K. Meffe& C. Ronald Carroll (2006), Sinauer Associates.

Books for Reference:

1. Global Biodiversity Assessment – V.H. Heywood (1995), Cambridge University Press.
2. Essentials of Conservation Biology – Richard B. Primack (2014), Sinauer Associates.
3. Handbook of Biodiversity Valuation: A Guide for Policy Makers – OECD (2002), OECD Publishing.

Websites and E-Learning Sources:

1. https://www.youtube.com/watch?v=ErATB1aMiSU
2. https://www.youtube.com/watch?v=plR4-Gp7uJY
3. https://www.youtube.com/watch?v=TIw_fmpnmUE

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Recall the basic concepts of biodiversity, its types, and significance.	**K1**
CO2	Understand the importance of biodiversity and its classification.	**K2**
CO3	Apply conservation methods for protecting endangered species.	**K3**
CO4	Analyze the impact of human activities on biodiversity loss.	**K4**
CO5	Evaluate policies and legal frameworks for biodiversity conservation.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UBT43AO02B**			**Allied Optional – 2:** Biodiversity and Conservation					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	3	2	2	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	1	1	3	2	2	3	2	1	**2.1**
CO5	2	1	2	2	2	3	2	2	3	2	**2.1**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43OP02A	**Allied Optional Practical - 2:** Molecular Genetics	2	1

Course Objectives
To understand and apply Mendel's laws of genetics through mono and dihybrid crosses.
To observe the rearing morphology of Drosophila and identify mutant phenotypes.
To study genetic model organisms like *Arabidopsis thaliana* and *Caenorhabditis elegans*.
To perform mutagenesis experiments and isolate spontaneous and petite mutant yeast cells.
To analyze karyotypes, Barr bodies, and polytene chromosomes in human and plant samples.

1. Dihybrid crosses.
2. Rearing morphology of Drosophila (mutant eye identification)
3. Observation of Genetic model organisms (Arabidopsis thaliana and Coenorrabditis elegans)- Permanent slides
4. Isolation of spontaneous mutant cells.
5. Isolation of petite mutant yeast cell.
6. Study the effect of physical mutagens on bacterial characteristics.
7. Karyotype analysis- Human (Normal and Abnormal) and onion.
8. Identification of Barr body (Buccal epithelium smear)
9. Preparation of polytene chromosomes (Chironomous larvae salivary gland)- squash preparation.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Methodology	Result submission and Viva

Books for Study:

1. Genetics: A Conceptual Approach (5th Edition, 2017) by Benjamin A. Pierce – 784 pages
2. Principles of Genetics (7th Edition, 2016) by D. Peter Snustad and Michael J. Simmons – 896 pages
3. Molecular Genetics of Bacteria (5th Edition, 2013) by Larry Snyder and Wendy Champness – 456 pages
4. Introduction to Genetic Analysis (11th Edition, 2017) by Anthony J. F. Griffiths et al. – 608 pages
5. Genetics*: From Genes to Genomes* (6th Edition, 2021) by Leland Hartwell et al. – 704 pages

Books for Reference:

1. *Genetics: A Laboratory Manual* by Leland Hartwell – 224 pages
2. *Essentials of Genetics* (8th Edition, 2015) by William S. Klug – 704 pages
3. *Genetics of Populations* (5th Edition, 2017) by Daniel L. Hartl – 600 pages

Websites and eLearning Sources:

1. *Mendelian Genetics and Dihybrid Crosses* – https://www.youtube.com/watch?v=Mehz7tCxjSE
2. *Understanding Drosophila Mutants: Morphology and Eye Mutations* – https://www.youtube.com/watch?v=XwMbWLUo-L4
3. *Karyotype Analysis: Identifying Chromosomal Abnormalities* – https://www.youtube.com/watch?v=V5d9wK-E-F0
4. *Polytene Chromosomes Preparation and Visualization* – https://www.youtube.com/watch?v=z7wZLzNTS0k
5. *Mutation Isolation in Yeast Cells* – https://www.youtube.com/watch?v=4Crf-d4y_vI

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recall the concepts of Mendel's laws of inheritance and basic genetic techniques like crosses, karyotype analysis, and mutation isolation.	**K1**
CO2	Explain the principles of genetic inheritance, the structure of chromosomes, and the effects of physical mutagens on organisms.	**K2**
CO3	Demonstrate experimental techniques for observing genetic traits and mutations in organisms such as *Drosophila*, yeast, and plants.	**K3**
CO4	Analyze genetic models through observation of mutant phenotypes, karyotypes, and chromosome preparations.	**K4**
CO5	Evaluate experimental data to identify mutations, abnormalities, and chromosome characteristics in organisms.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UBT43OP02A**			**Allied Optional Practical - 2:** Molecular Genetics					**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	2	3	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	2	1	2	3	2	3	1	2	3	2	**2.1**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT43OP02B	**Allied Optional Practical - 2:** Biodiversity and Conservation	2	1

Course Objectives
To identify and classify microbial species from different environmental samples.
To extract and analyze DNA from plants, animals, or microbes using molecular techniques.
To assess microbial roles in bioremediation of pollutants.
To culture and propagate endangered plant species using tissue culture techniques.
To evaluate microbial diversity using sequencing and biochemical methods.

1. Identifying microbes from soil and water using simple lab techniques.
2. Extracting DNA from plants or animals and analyzing it using PCR.
3. Testing how microbes help clean pollutants in soil and water.
4. Studying genetic differences in plants or microbes using basic lab methods.
5. Growing endangered plants in test tubes using tissue culture.
6. Checking microbial diversity in soil using simple sequencing techniques.
7. Measuring enzyme activity in microbes that help break down waste.
8. Testing how bacteria or fungi survive in polluted environments.
9. Studying plant genes that help them survive in tough conditions.
10. Learning how to freeze seeds and plant tissues for long-term storage.

Teaching Methodology	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Methodology	Result submission and Viva

Books for Study:

1. Biodiversity and Conservation – Michael J. Jeffries, 2nd Edition, 2006.
2. Molecular Biology and Biotechnology – John M. Walker, 5th Edition, 2014.
3. Environmental Biotechnology: Principles and Applications – Bruce E. Rittmann & Perry L. McCarty, 2nd Edition, 2012.

Books for Reference:

1. Principles of Conservation Biology – Martha J. Groom, Gary K. Meffe& C. Ronald Carroll, 3rd Edition, 2006.
2. Biotechnology and Biodiversity – John A. Thomas, 1st Edition, 2004.
3. Microbial Diversity and Bioprospecting – Alan T. Bull, 1st Edition, 2004.

Websites and eLearning Sources:

1. https://nptel.ac.in/courses/102/106/102106081/
2. https://www.youtube.com/watch?v=FzVL4l3OUWc
3. https://www.coursera.org/learn/conservation-biology

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	Recall the importance of microbes and plants in maintaining biodiversity.	**K1**
CO2	Explain the role of microbes and plants in biodiversity conservation.	**K2**
CO3	Apply molecular techniques to analyze genetic diversity in microbial and plant species.	**K3**
CO4	Analyze microbial and genetic data to assess environmental changes and biodiversity loss.	**K4**
CO5	Evaluate conservation strategies using biotechnological approaches for protecting biodiversity.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UBT43OP02B**			**Allied Optional Practical - 2:** Biodiversity and conservation					**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	2	3	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	2	1	2	3	2	3	1	2	3	2	**2.1**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours / Week	Credits
4	25UHE44VE04A	**Value Education - 4:** Social Ethics - 2	2	1

Course Objectives
To understand the significance of natural resources and strive to coexist harmoniously with nature.
To implement strategies for disaster management within the community.
To evaluate the significance and distinctions between science and religion.
To recognize the importance of maintaining a healthy lifestyle.
To utilize counseling techniques to address and resolve individuals' issues.

UNIT I: Harmony with Nature (6 Hours)

What is environment, why should we think of harmony, longing for human well-being, Principles to conserve environmental resources, causes of disharmony, the fruits of harmony with nature, Forest resources, Water resources, Mineral resources, Food resources, Fruits of disharmony, Economic values and growth, Environmental Ethics, Guidelines to live in harmony with nature, Towards life-centered system for better quality of life. Harmony with animal kingdom.

UNIT II: Issues Dealing with Science and Religion (6 Hours)

What is Science, Science and Religion, Social Relevance of Science and Technology, Science and technology for social justice, Difference caused by Science and Technology, Need for indigenous technology, Science, Technology and Innovation Policy of India.

UNIT III: Public Health (6 Hours)

Health related issues, Health Care in India vs Developed Countries, Health and Heredity, Public Health - The Indian Scenario, Objectives of public health in India, Public Health System in India, Failure on the public health front, Role of the central government, Hospitals Services in India, Health and Abortion, Health and Drug Addiction, Drug abuse.

UNIT IV: Disaster Management (6 Hours)

Disaster Management, Types of disaster, plans of disaster management, Technology to manage natural disasters and catastrophes, Disaster Management, Rehabilitation and Reconstruction, Human-induced disaster, First Aid, The importance of First-aid, Disaster Declaration and Response.

UNIT V: Counseling for Adolescents (6 Hours)

High Risk Behaviours, Developmental Changes in Adolescents, Key Issues of the Adolescents, need for Counseling, Nature of Counseling, Counseling Goals, does helping help? The Good and the Bad news. Importance of Career Guidance Counseling.

Teaching Methodology	Power point, Assignment and Group discussion
Assessment Methods	Online Test, Group Discussions, Seminar, Assignment

Books for Study:

1. Department of Human Excellence. (2021). *Formation of Youth*, St Joseph's College (Autonomous), Tiruchirappalli.

Books for Reference:

1. Albert, D., & Steinberg, L. *Judgment and decision making in adolescence*: Journal of Research on
2. Adolescence, page no: 211-224 (2011).
3. Larry, R. C. (2000). *Disaster Management and Preparedness,* Lewis Publications.
4. Hurlock, E.B. (2001). *Developmental Psychology: A: Life-Span Approach*. (5th Ed.). Tata McGraw-Hill.
5. Sangha., & Kamaljit. (2015). *Ways to Live in Harmony with Nature: Living Sustainably and*
6. *Working with Passion.* Australia, Woods lane Pty Limited.

Websites and eLearning Sources:

1. https://en.wikipedia.org/wiki/Disaster_management_in_India
2. https://ndma.gov.in/
3. https://talkitover.in/services/child-adolescent-counselling/
4. https://www.nipccd.nic.in/schemes/adolescent-guidance-centre-19#gsc.tab=0

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Know the value of natural recourses and to live in a harmony with nature.	**K1**
CO2	Apply the plans of disaster management in the society.	**K2**
CO3	Analyse the importance and differences of science and religion.	**K3**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**25UHE44VE04A**			**Value Education - 4:** Social Ethics - 2						**2**	**1**
Course Outcome	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	2	3	3	**2.8**
CO2	3	2	2	3	3	2	3	3	2	2	**2.5**
CO3	2	3	3	3	2	3	3	3	3	3	**2.8**
										Mean Overall Score	**2.7 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UHE44VE04B	**Value Education - 4:** Religious Doctrine - 2	2	1

Course Objectives
To explore the rich historical background of the Catholic Church
To explore and comprehend the Sacraments practiced by the Catholic Church
To incorporate Christian Prayer into daily routines
To reflect on personal growth through the lens of Sacraments and Christian Prayer
To promote unity by embracing universal values from various religions

UNIT I **:** The Catholic Church **(6 Hours)**

UNIT II **:** Sacraments of Initiation **(6 Hours)**

UNIT III **:** Sacraments of Healing & at the Service of Community **(6 Hours)**

UNIT IV **:** The Christian Prayer **(6 Hours)**

UNIT V **:** Harmony of Religions **(6 Hours)**

Teaching Methodology	Power point, assignment, and Group discussion
Assessment Methods	Seminars, Group Discussion, Online Tests, Assignments

Books for Study:

1. Department of Human Excellence (2022). Fullness of Life, St Joseph's College (Autonomous), Tiruchirappalli.

Books for Reference:

1. (1994). *Compendium: Catechism of the Catholic Church.* Bengaluru: Theological Publications in India. Holy Bible (NRSV).

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	Understand the history of the Catholic Church	**K1**
CO2	Examine and grasp the Sacraments of the Catholic Church	**K2**
CO3	Apply the Christian Prayer to their everyday life	**K3**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**25UHE44VE04B**			**Value Education - 4:** Religious Doctrine - 2						**2**	**1**
Course Outcome	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	2	3	3	**2.7**
CO2	3	2	2	2	3	3	3	3	2	2	**2.5**
CO3	2	2	3	3	2	2	3	3	3	3	**2.6**
										Mean Overall Score	**2.6 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT44SE02	**Skill Enhancement Course – 2:** Mushroom Cultivation	2	1

Course Objectives
To introduce students to the basic concepts of mushroom biology and cultivation.
To develop practical skills in spawn preparation and substrate selection.
To provide knowledge on different types of mushrooms and their nutritional value.
To train students in disease management and post-harvest processing of mushrooms.
To explore the commercial and entrepreneurial opportunities in mushroom cultivation.

UNIT I **(6 Hours)**

Introduction to Mushroom Cultivation: History and importance of mushroom cultivation, Nutritional and medicinal value of mushrooms, Classification of edible and medicinal mushrooms, Life cycle and morphology of mushrooms.

UNIT II **(6 Hours)**

Spawn Production and Substrate Preparation: Selection of mushroom species for cultivation, Types of substrates, Preparation of spawn, Sterilization techniques for substrates and spawn.

UNIT III **(6 Hours)**

Cultivation Methods: Different cultivation techniques, Environmental conditions, Harvesting and yield assessment, Troubleshooting common cultivation problems.

UNIT IV **(6 Hours)**

Pest and Disease Management: Common fungal, bacterial, and viral diseases, Pest control strategies, Hygiene and sanitation measures.

UNIT V **(6 Hours)**

Post-Harvest Processing and Entrepreneurship: Drying, packaging, and storage, Value-added mushroom products, Economic potential and business opportunities, Marketing Statergies. Government schemes and funding.

Teaching Methodology	Chalk and Talk, PPT and Animation Videos
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Handbook of Mushroom Cultivation, Processing, and Packaging by S. T. Chang – 2016, 342 pages.
2. Mushroom Cultivation: A Practical Guide to Growing Mushrooms at Home by Paul Stamets – 2011, 416 pages.
3. Edible and Medicinal Mushrooms: Technology and Applications by Diego Cunha Zied and Artur Beteta Martínez – 2021, 520 pages.
4. Mushroom Biotechnology: Developments and Applications by Arun Arya and Manish Yadav – 2019, 340 pages.
5. Mushroom Farming: A Step-by-Step Guide to Cultivation by Richard Bray – 2020, 192 pages.

Books for Reference:

1. Biology and Cultivation of Edible Mushrooms by S. T. Chang and Philip G. Miles – 2004, 480 pages.
2. The Mushroom Cultivator: A Practical Guide to Growing Mushrooms at Home by Paul Stamets and J.S. Chilton – 1983, 415 pages.
3. Advances in Mushroom Biotechnology by M. Maheshwari – 2017, 320 pages.

Websites and E-Learning Sources:

1. https://www.youtube.com/watch?v=6Ndrhx1ch64
2. https://www.youtube.com/watch?v=9xP7oH8AVnw
3. https://www.youtube.com/watch?v=aB0GA6UZk3c

4. https://www.youtube.com/watch?v=J2FQVwU1uFc
5. https://www.youtube.com/watch?v=YEf1y21-FqA

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Identify different types of edible and medicinal mushrooms.	**K1**
CO2	Explain the principles of mushroom cultivation and the role of environmental factors.	**K2**
CO3	Demonstrate the process of spawn preparation, substrate sterilization, and mushroom cultivation.	**K3**
CO4	Interpret disease symptoms and suggest effective management strategies.	**K4**
CO5	Assess the commercial potential and develop a business plan for mushroom farming.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**25UBT44SE02**			**Skill Enhancement Course - 2:** Mushroom Cultivation					**2**		**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	2	3	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	2	1	2	3	2	3	1	2	3	2	**2.1**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25UBT44SL03	**Self-Learning:** Environmental Biotechnology	-	2

Course Objectives
To understand the role of biotechnology in solving environmental issues.
To explore various bioremediation and waste management techniques.
To learn about pollution control strategies and the use of microorganisms.
To study renewable energy sources and sustainable biotechnological innovations.
To analyze emerging applications and future prospects of environmental biotechnology.

UNIT I

Introduction to Environmental Biotechnology: Definition and scope of environmental biotechnology, Role of microorganisms in environmental management, Biogeochemical cycles and their significance, Environmental pollutants and their impact on ecosystems.

UNIT II

Bioremediation and Waste Management: Types of bioremediations (in-situ and ex-situ), Microbial degradation of xenobiotics, Treatment of industrial and domestic wastewater, Solid waste management techniques.

UNIT III

Pollution Control Strategies: Biofilters and bioscrubbers, Phytoremediation techniques, Use of genetically modified organisms (GMOs) in pollution control, Bioindicators and biosensors for environmental monitoring.

UNIT IV

Renewable Energy and Sustainable Technologies: Production of biofuels (biogas, bioethanol, biodiesel), Microbial fuel cells, Algal biofuel production, Carbon sequestration and climate change mitigation.

UNIT V

Applications and Regulatory Aspects of Environmental Biotechnology: Bioplastics and biodegradable materials, Environmental impact assessment (EIA), Eco-friendly technologies in industries, Policies and regulations for environmental biotechnology.

Teaching Methodology	Videos, PPTandAnimation Videos
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Rittmann, B. E., & McCarty, P. L. (2001). *Environmental Biotechnology: Principles and Applications* (2nd ed.). McGraw-Hill.
2. Singh, A. (2021). *Environmental Microbiology and Biotechnology* (1st ed.). Springer.
3. Metcalf, L., & Eddy, H. P. (2014). *Wastewater Engineering: Treatment and Reuse* (5th ed.). McGraw-Hill.
4. Alexander, M. (1999). *Biodegradation and Bioremediation* (2nd ed.). Elsevier.
5. Rehm, W., & Reed, G. (2011). *Industrial and Environmental Biotechnology* (1st ed.). Wiley-VCH.

Books for Reference:

1. Cheremisinoff, N. P. (2001). *Biotechnology for Wastewater Treatment* (1st ed.). Butterworth-Heinemann.
2. Atlas, R. M., & Bartha, R. (1997). *Microbial Ecology: Fundamentals and Applications* (4th ed.). Benjamin/Cummings.
3. Mohapatra, P. K. (2020). *Textbook of Environmental Biotechnology* (1st ed.). Springer.

WebsitesandE-Learning Sources:

1. https://www.youtube.com/watch?v=xxxxxx
2. https://www.youtube.com/watch?v=YyUJ_YAYVsY
3. https://www.youtube.com/watch?v=DLFhv7gUm6o

4. https://www.youtube.com/watch?v=htv6Xl7DWz0
5. https://www.youtube.com/watch?v=2v_jHGeA7EY

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Identify various environmental pollutants, microorganisms involved in bioremediation, and key biogeochemical cycles.	**K1**
CO2	Describe the role of microorganisms in pollution control, waste management, and renewable energy production.	**K2**
CO3	Demonstrate bioremediation techniques, analyze microbial interactions in waste treatment, and assess pollution levels using biosensors.	**K3**
CO4	Compare different pollution control strategies, evaluate the efficiency of biofilters, and assess the impact of GMOs in environmental biotechnology.	**K4**
CO5	Critically evaluate sustainable biotechnological solutions, assess environmental policies, and recommend eco-friendly industrial applications.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**				**Hours**			**Credits**
4	**25UBT44SL03**			**Self-Learning:** Environmental Biotechnology				**-**			**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	2	3	2	2	3	**2.5**
CO2	2	2	1	3	2	2	1	2	3	2	**2.0**
CO3	3	1	2	2	3	3	2	1	3	2	**2.2**
CO4	3	3	2	1	2	2	2	3	2	1	**2.1**
CO5	2	1	2	3	2	3	1	2	3	2	**2.1**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53CC09	**Core Course - 9:** Genomics and Proteomics	5	4

Course Objectives
To understand the organization and structure of genomes, and the role of genomic sequencing techniques in exploring genetic information.
To acquire knowledge of transcriptomics for gene expression analysis.
To learn various protein analysis techniques.
To explore the significance of the human genome for drug development and identification of novel drug targets.
To study the principles of metabolomics for analyzing and understanding evolutionary relationships.

UNIT I **(15 Hours)**

Structure and organization of prokaryotic and eukaryotic genomes: Definition of genomics and proteomics. Nucleotide sequencing methods, automated sequencing, Approaches to whole genome sequencing.

UNIT II **(15 Hours)**

Transcriptomics: Transcript analysis – global gene expression analysis, micro arrays – differential gene expression. Non array based whole transcriptome analysis, differential display, serial analysis of gene expression (SAGE).

UNIT III **(15 Hours)**

Proteomics: Protein analysis – Proteome – 2D analysis of proteins – differential display proteomics, protein – protein interactions, yeast two – hybrid system and phage display. Computational approaches to protein interaction. Liquid chromatography – Mass spectrometry based high throughput proteome analysis.

UNIT IV **(15 Hours)**

Pharmacogenomics: Human genome and science after genome era, pharmacogenomics – high throughput screening for discovery and identification of drugs. Drug targets and development. SNP analysis.

UNIT V **(15 Hours)**

Metabolomics: Metabalomics and networks Systems biology principles. Computational approaches to phenomics. Phylogenomics.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Proteomics Research: New Frontiers in Functional Genomics (Principles and Practice) (1997). Edited by M.R. Wilkins. K.L. Williams, R.D. Apel and D.F. Hochstrasser, Springer Verlag, New York.

Books for Reference:

1. Expression Genetics: Accelerated and High Throughput Methods (1999) Edition by M. McClelland and Arthur Pardee, Biotechniques Press, Eaton Publishing.
2. 2-D Proteome Analysis Protocols Edited by Andrew J. Link, 1998. Humana Press.
3. DNA microarrays: A practical approach (1999). Edited by Mark Schena, Oxford University Press, Oxford, England.
4. Reviews and articles from Journals such as Nature, Sciences, PNAS (USA), Nuclei Acids Research, Trends Series & Current Opinion Series.

Websites and eLearning Sources:

1. https://genomemedicine.biomedcentral.com/articles/10.1186/s13073-022-01075-1
2. https://www.technologynetworks.com/proteomics/articles/proteomics-principles-techniques-and-applications-343804
3. https://www.intechopen.com/chapters/68486

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Describe the structure and organization of prokaryotic and eukaryotic genomes and apply various nucleotide sequencing methods.	**K1**
CO2	Analyze global gene expression using microarrays, non-array based transcriptomics techniques, and differential gene expression methods, and understand the application of these tools in various biological contexts.	**K2**
CO3	Perform protein analysis through 2D gel electrophoresis, differential display proteomics, and identify protein-protein interactions.	**K3**
CO4	Understand the role of genomics and pharmacogenomics in drug discovery.	**K4**
CO5	Apply systems biology principles and computational approaches in metabolomics as well as explore evolutionary relationships.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
5	**25UBT53CC09**			**Core Course - 9:** Genomics and Proteomics					**5**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	2	3	2	1	1	2	**2.2**
CO2	3	3	2	1	1	3	3	1	2	2	**2.1**
CO3	2	3	2	2	2	3	2	2	1	2	**2.1**
CO4	2	3	2	2	2	3	2	3	3	3	**2.5**
CO5	2	3	2	2	2	3	2	1	2	2	**2.1**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53CC10	**Core Course - 10:** Food Biotechnology	5	3

CourseObjectives
To introduce students to the fundamental concepts, scope and applications of food biotechnology.
To explore microbial and enzymatic applications in the food industry.
To understand biotechnological approaches in food processing and preservation.
To analyze the development and impact of genetically modified foods.
To examine food safety regulations, quality control measures, and recent advancements in food biotechnology.

UNIT I **(15 Hours)**

Introduction to Food Biotechnology: Definition and scope of food biotechnology, History and development of food biotechnology, Microorganisms in food biotechnology: beneficial and harmful microbes, Traditional and modern fermented foods.

UNIT II **(15 Hours)**

Microbial and Enzymatic Applications in Food Industry: Microbial fermentation and its applications in food processing, Food-grade enzymes: sources, production, and applications, genetically modified microorganisms (GMM) in food production, Probiotics, prebiotics, and their role in gut health.

UNIT III **(15 Hours)**

Food Processing and Preservation Techniques: Biotechnological approaches in food processing, Food spoilage and control methods, Bio-preservation techniques: bacteriocins, natural antimicrobial agents, Role of biotechnology in improving shelf life and nutritional value.

UNIT IV **(15 Hours)**

Genetically Modified Foods: Concept, production, and advantages of GM foods, Examples: Golden Rice, Bt crops, and Flavr Savr tomato, Risk assessment and ethical concerns of GM foods, Labeling, consumer perception, and regulatory issues.

UNIT V **(15 Hours)**

Food Safety, Quality Control, and Regulations: HACCP (Hazard Analysis and Critical Control Points) principles, Foodborne diseases and their control Role of biotechnology in food safety, Food laws and regulatory agencies: FSSAI, FDA, EFSA, Codex Alimentarius, Functional foods and nutraceuticals, Bioplastics and sustainable packaging solutions, Role of nanotechnology in food processing, Future trends in food biotechnology.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Frazier and Westhoff, DC. 1988. Food Microbiology. TATA McGraw Hill Publishing Company LTD., New Delhi.

Books for Reference:

1. Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge
2. Maheshwary. Nutrition and dietetic. New Delhi.

Websites and eLearning Sources:

1. https://microbenotes.com/fermentation/
2. https://www.nios.ac.in/media/documents/srsec321newE/321-E-Lesson-9.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000444FN/P000547/M011750/ET/1533293651Q-I.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the principles and applications of food biotechnology, including its historical development, microbial roles, and fermentation technologies in food production.	**K1**
CO2	Analyze the role of microorganisms and enzymes in food processing, including their applications in fermentation, probiotics, and genetically modified microorganisms (GMM) for enhanced food quality.	**K2**
CO3	Apply biotechnological techniques in food preservation and quality enhancement, understanding food spoilage control, bio preservation methods, and improving nutritional value.	**K3**
CO4	Evaluate the benefits, risks, and ethical concerns of genetically modified (GM) foods, including their production, labeling, and global regulatory frameworks.	**K4**
CO5	Demonstrate knowledge of food safety regulations, HACCP principles, and emerging trends in food biotechnology, such as functional foods, bioplastics, and nanotechnology in food processing.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT53CC10**			**Core Course - 10:** Food Biotechnology						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	1	2	3	1	2	1	2	**2.1**
CO2	3	3	2	2	2	2	2	2	2	2	**2.2**
CO3	3	3	3	2	1	3	3	1	1	2	**2.2**
CO4	3	3	3	2	2	2	2	2	3	2	**2.4**
CO5	2	2	2	2	2	2	2	3	3	2	**2.2**
Mean Overall Score											**2.22 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53CC11	**Core Course - 11:** Nanobiotechnology	5	3

Course Objectives
To introduce the fundamental concepts of nanotechnology and its applications in biological sciences.
To explore the synthesis and characterization of nanomaterials, including metallic, polymeric, and biological nanoparticles.
To understand the interaction of nanomaterials with biological systems, including cellular uptake, toxicity, and applications in medicine.
To study the role of nanotechnology in drug delivery, diagnostics, biosensors, and environmental applications.
To provide insights into the ethical, safety, and regulatory aspects of nanobiotechnology in industry and healthcare.

UNIT I **(15 Hours)**

Introduction to Nanobiotechnology: Definition, scope, and significance of nanobiotechnology, History and development of nanotechnology in biology, Properties of nanomaterials, Types of nanomaterials: Optical, electrical, magnetic, and mechanical properties, biological molecules as nanostructures: Proteins, DNA, lipids, and carbohydrates.

UNIT II **(15 Hours)**

Synthesis and Characterization of Nanomaterials: Methods of nanoparticle synthesis: Physical, chemical, and biological approaches, Green synthesis of nanoparticles using plants, microbes, and biomolecules, Characterization techniques: SEM, TEM, AFM, XRD, DLS, FTIR, and UV-Vis spectroscopy.

UNIT III **(15 Hours)**

Interaction of Nanomaterials with Biological Systems: Mechanisms of nanoparticle-cell interactions, Cellular uptake and toxicity of nanoparticles, Nanotoxicology and safety assessment, Biodegradability and bio-compatibility of nanomaterials

UNIT IV **(15 Hours)**

Applications of Bionanotechnology in Medicine and Healthcare: Nanoparticles in drug delivery: Liposomes, dendrimers, polymeric nanoparticles, Nanodiagnostics: Biosensors, quantum dots, and lab-on-a-chip systems, Nanotechnology in tissue engineering and regenerative medicine, Cancer therapy and targeted drug delivery using nanotechnology.

UNIT V **(15 Hours)**

Nanotechnology in Agriculture and Environment: Nanoparticles in agriculture: Nano-fertilizers, nano-pesticides, and soil remediation, Role of nanotechnology in water purification and environmental monitoring, Nanomaterials for sustainable energy production, antimicrobial applications of nanotechnology in food and packaging, Ethical concerns and societal impact of nanotechnology and Risk assessment and regulatory frameworks for nanoproducts.

Teaching Methodology	Chart, PPT, Videos, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Ratner, M. A., & Ratner, D. (2020). Nanotechnology: A Gentle Introduction to the Next Big Idea (2nd Edition). Pearson Education.
2. Goodsell, D. S. (2021). Bionanotechnology: Lessons from Nature (2nd Edition). Wiley-Liss.
3. Sahoo, S. K. (2021). Bionanotechnology: Concepts and Applications (2nd Edition). CRC Press**.**

Books for Reference:

1. Bhushan, B. (2022). Handbook of Nanotechnology (4th Edition). Springer**.**
2. Duncan, T. V., & Morrissey, M. T. (2020). Nanotechnology in Food and Agriculture. Springer.
3. Freitas, R. A. (2019). Nanomedicine, Vol. I: Basic Capabilities. Landes Bioscience.

4. Roco, M. C., & Bainbridge, W. S. (2018). Societal Implications of Nanoscience and Nanotechnology. Springer.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC10168541/pdf/fmicb-14-1155622.pdf
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC3517211/pdf/nihms-401532.pdf
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC10536529/pdf/molecules-28-06624.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Describe the fundamental principles of nanotechnology and its applications in biological sciences.	**K1**
CO2	Explain the methods for synthesis and characterization of nanomaterials used in biotechnology and medicine.	**K2**
CO3	Analyze the interaction of nanomaterials with biological systems, including their uptake, toxicity, and biocompatibility.	**K3**
CO4	Demonstrate knowledge of the applications of bionanotechnology in drug delivery, diagnostics, agriculture, and environmental protection.	**K4**
CO5	Understand ethical, safety, and regulatory issues associated with nanotechnology and its commercialization.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT53CC11**			**Core Course - 11:** Nanobiotechnology						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	3	3	1	2	2	**2.1**
CO2	3	3	2	2	1	3	3	2	2	2	**2.3**
CO3	2	3	3	3	2	3	3	2	2	2	**2.5**
CO4	2	3	3	3	2	3	3	2	2	3	**2.6**
CO5	2	3	2	3	3	3	2	2	2	3	**2.5**
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53CP05	**Core Practical - 5:** Genomics and Proteomics, Food Biotechnology and Nanobiotechnology	3	1

Course Objectives
To equip students with bioinformatics skills such as primer designing, sequence alignment, phylogenetic analysis, and molecular visualization techniques.
To provide hands-on training in food microbiology techniques, including isolation, enumeration, and identification of microorganisms in food samples.
To enable students to detect food spoilage organisms and adulterants in various food products using microbiological and biochemical methods.
To introduce students to the principles of bionanotechnology, focusing on the green synthesis and characterization of nanoparticles.
To develop analytical and research skills through the study of nanoparticle interactions with biological systems, including hemolysis assays and antibacterial activity tests.

Genomics and Proteomics

1. Primer designing
2. Sequence analysis: Pairwise alignment (BLAST).
3. Sequence analysis: Multiple alignment (Clustal W).
4. Six Frame Translation.
5. Phylogenetic analysis.
6. Molecular visualization using Rasmol

Food Biotechnology

7. Isolation and enumeration of microorganisms from food samples (Total Plate Count)
8. Detection of food spoilage microorganisms (Yeasts, molds, and bacteria)
9. Gram staining and identification of bacteria in food samples
10. Microbial examination of fermented foods (Yogurt, curd, pickles)
11. Detection of adulterants in milk, honey, and food grain
12. Production of amylase/protease by microbial fermentation

Bionanotechnology

13. Green synthesis of silver/gold nanoparticles using plant extracts or microbial sources.
14. Characterization using UV-Vis spectroscopy, Dynamic Light Scattering (DLS), and zeta potential.
15. SEM imaging for morphological analysis of nanoparticles.
16. Hemolysis assay to assess the interaction of nanoparticles with red blood cells.
17. Antibacterial activity of nanoparticles against pathogenic bacteria.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Methods	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Bioinformatics: Sequence and Genome Analysis**,** David W. Mount, 2004 (2nd Edition), Cold Spring Harbor Laboratory Press.
2. Fundamentals of Food Biotechnology**,** Byong H. Lee, 2014 (2nd Edition), Wiley-Blackwell.
3. Bionanotechnology: Lessons from Nature, David S. Goodsell, 2004, Wiley-Liss

Books for Reference:

1. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, Tuan Vo-Dinh, 2007, CRC Press
2. Food Microbiology: Fundamentals and Frontiers, Michael P. Doyle and Robert L. Buchanan, 2012 (4th Edition), ASM Press.

Websites and eLearning Resources:

1. https://www.youtube.com/watch?v=nf-Bd3u7MDM

2. https://www.youtube.com/watch?v=YVA1veTn8aU
3. https://www.youtube.com/watch?v=XMCax-kAQ5c
4. https://www.youtube.com/watch?v=XMCax-kAQ5c
5. https://www.youtube.com/watch?v=YVA1veTn8aU

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Design primers and perform sequence alignment using bioinformatics tools like BLAST and Clustal W for genomic and proteomic studies.	**K1**
CO2	Isolate, identify, and enumerate microorganisms from food samples, assess microbial contamination, and analyze fermented food products.	**K2**
CO3	Detect food spoilage microorganisms and adulterants in milk, honey, and food grains using microbiological and biochemical techniques.	**K3**
CO4	Synthesize silver/gold nanoparticles using eco-friendly methods and characterize them using UV-Vis spectroscopy, DLS, and SEM imaging.	**K4**
CO5	Evaluate the biological applications of nanoparticles, including their hemolytic activity and antibacterial properties against pathogenic bacteria.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT53CP05**			**Core Practical - 5:** Genomics and Proteomics, Food Biotechnology and Nanobiotechnology						**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
									Mean Overall Score		**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53ES01A	**Discipline Specific Elective - 1:** Bioethics, IPR and Biosafety	4	3

Course Objectives
To introduce students to the ethical issues and conflicts that arise in the biological sciences.
To provide an understanding of the ethical issues and safety considerations in biotechnology.
To equip students with the ability to assess environmental risks associated with genetically modified organisms (GMOs).
To provide students with a comprehensive understanding of intellectual property rights (IPR),
To equip students with knowledge of the patenting process.

UNIT I **(12 Hours)**

Bioethics: Ethical conflicts in biological sciences - bioethics in health care, Artificial reproductive technologies, Ethics in transplantation and stem cell research. Animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk. Protection of environment and biodiversity – biopiracy.

UNIT II **(12 Hours)**

Biosafety: Ethical issues concerning biotechnology, Primary containment for biohazards, Recommended biosafety levels for specific microorganisms, Biosafety guidelines for industrial operations with GMOs, Field trial of GM crops.

UNIT III **(12 Hours)**

Food safety issues: Environmental risk assessment and food and feed safety assessment, Balance of genetically altered and natural population in an ecosystem, Safety of modified crops, Livestock as food and their nutritional values, Social and economic effects.

UNIT IV **(12 Hours)**

IPR: Different forms of IPR; General concept of patenting; Indian Patent Act 1970; Current Indian patent law, rules and regulation. Basics of patents: types of patents; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application.

UNIT V **(12 Hours)**

Role of a Country Patent Office: Filing of a patent application. Examples for any plant, microbe, animal patents, Patenting of drugs, Food products, new inventions.

Teaching Methodology	Chart, PPT, Videos, Chalk and talk.
Assessment Methods	Quiz, Assignments, MCQs, Seminars and Group Discussions

Books for Study:

1. Rajmohan Joshi, Biosafety And Bioethics 01 Edition, 2006. Isha Books.

Books for Reference:

1. M.K. Sateesh, Bioethics and Biosafety 2008 . I K International Publishing House.
2. Goel And Parashar, IPR, Biosafety and Bioethics, 1e Paperback – 2013, Pearson.

Websites and eLearning Sources:

1. https://www.ncbi.nlm.nih.gov/books/NBK26887/
2. https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf
3. https://plato.stanford.edu/entries/theory-bioethics/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Identify and analyze ethical conflicts in biological sciences, including topics like healthcare bioethics, artificial reproductive technologies, stem cell research, animal rights, and environmental risk concerns associated with agricultural biotechnology.	**K1**
CO2	Apply biosafety guidelines in biotechnology research and industrial operations, including understanding biosafety levels for microorganisms, and the procedures for safe handling and field trials of GM crops.	**K2**
CO3	Evaluate food safety issues, including the environmental risks and social implications of genetically modified organisms (GMOs), and assess the nutritional value and safety of modified crops and livestock.	**K3**
CO4	Understand and navigate the principles of intellectual property rights, with a particular focus on patent law.	**K4**
CO5	To file patent applications and understand the role of patent offices.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
5	**25UBT53ES01A**			**Discipline Specific Elective - 1:** Bioethics, IPR and Biosafety					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	2.4
CO2	2	3	2	1	2	3	1	2	3	3	2.2
CO3	2	2	2	3	1	2	2	3	2	2	2.1
CO4	3	2	2	1	3	3	1	3	2	3	2.4
CO5	2	3	2	3	1	3	2	3	2	1	2.2
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53ES01B	**Discipline Specific Elective - 1:** Cancer Biology	4	3

Course Objectives
To understand the fundamental concepts of cancer biology, including cancer initiation and progression.
To explore the molecular and genetic mechanisms underlying tumor development and metastasis.
To study the role of oncogenes, tumor suppressor genes, and signaling pathways in cancer.
To examine various diagnostic techniques and therapeutic approaches for cancer treatment.
To familiarize students with recent advances in cancer research, including targeted therapies and immunotherapy.

UNIT I **(12 Hours)**

Fundamentals of Cancer Biology: Definition and characteristics of cancer, Benign vs. malignant tumors, Hallmarks of cancer, Multistage carcinogenesis: initiation, promotion, and progression, Cancer classification and staging

UNIT II **(12 Hours)**

Molecular and Genetic Basis of Cancer: Oncogenes and proto-oncogenes, Tumor suppressor genes (p53, Rb, BRCA1/2), Role of growth factors and receptors in cancer, Epigenetics and cancer, Genomic instability and mutation in cancer

UNIT III **(12 Hours)**

Cell Cycle, Apoptosis, and Tumor Microenvironment: Regulation of the cell cycle and checkpoints, Apoptosis and its role in cancer, Angiogenesis and its role in tumor growth, Tumor microenvironment and metastasis, Cancer stem cells and their significance

UNIT IV **(12 Hours)**

Diagnosis and Treatment of Cancer: Cancer biomarkers and detection techniques (PCR, ELISA, Immunohistochemistry, Imaging techniques), Conventional cancer therapies: surgery, radiation, and chemotherapy, Targeted therapy and personalized medicine, Role of nanotechnology in cancer therapy, Immunotherapy and cancer vaccines

UNIT V **(12 Hours)**

Advances in Cancer Research and Future Directions: Role of genomics and proteomics in cancer research, CRISPR-Cas9 and gene therapy in cancer treatment, Liquid biopsy and its clinical applications, Cancer prevention strategies and lifestyle modifications, Ethical issues in cancer research and treatment

Teaching Methodology	Chart, PPT, Videos, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Weinberg, R.A. (2013). *The Biology of Cancer*. Garland Science, 2nd Edition.
2. King, R.J.B. & Robins, M.W. (2006). *Cancer Biology*. Pearson Education, 3rd Edition.
3. Pelengaris, S. & Khan, M. (2013). *The Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics*. Wiley-Blackwell, 2nd Edition.

Books for Reference:

1. Lodish, H., Berk, A., Kaiser, C.A., et al. (2021). *Molecular Cell Biology*. W. H. Freeman, 9th Edition.
2. Alberts, B., Johnson, A., Lewis, J., et al. (2014). *Molecular Biology of the Cell*. Garland Science, 6th Edition.
3. Vogelstein, B., & Kinzler, K.W. (2002). *The Genetic Basis of Human Cancer*. McGraw-Hill.

Websites and eLearning Sources

1. https://www.ncbi.nlm.nih.gov/books/NBK26902/#:~:text=Most%20of%20the%20genes%20found,divide%2C%20differentiate%2C%20or%20die.
2. https://publications.iarc.fr/_publications/media/download/3769/db3d8eb61b97256e23c4e313f7b028381eede9d2.pdf

3. https://pmc.ncbi.nlm.nih.gov/articles/PMC1550296/pdf/neo0204_0291.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the biological basis of cancer development and its hallmarks.	**K1**
CO2	Describe the genetic and molecular mechanisms contributing to oncogenesis.	**K2**
CO3	Analyze the role of cell cycle regulation, apoptosis, and tumor microenvironment in cancer progression.	**K3**
CO4	Evaluate various diagnostic and therapeutic strategies used in cancer treatment.	**K4**
CO5	Demonstrate an understanding of emerging trends in cancer research, including precision medicine and personalized therapies.	**K5**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**							**Hours**		**Credits**
5	**25UBT53ES01B**	**Discipline Specific Elective - 1:** Cancer Biology							**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	2.4
CO2	2	3	2	1	2	3	1	2	3	3	2.2
CO3	2	2	2	3	1	2	2	3	2	2	2.1
CO4	3	2	2	1	3	3	1	3	2	3	2.4
CO5	2	3	2	3	1	3	2	3	2	1	2.2
										Mean Overall Score	2.3 (Medium)

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53ES02A	**Discipline Specific Elective - 2:** Research Methodology	4	3

Course Objectives
To obtain knowledge on basic concepts in research.
To understand the objective of research.
To evaluate the significance of databases and citation index.
To plan basic research and the research process.
To acquire skill in writing research articles and formatting he papers.

UNIT I **(12 Hours)**

Research: Meaning, Definition and Objectives. Hypothesis: definition and types. Understanding the language of research - Concept, Construct, Variable. Research Process.

UNIT II **(12 Hours)**

Research Design: Concept, classification and Importance in Research. Features of a good research design. Experimental Design: Concept of Independent and group research.

UNIT III **(12 Hours)**

Bibliometrics: definition and relevance; Bibliometrics databases, h-index, SNIP, Page Rank, Impact Factor and evaluation. The use of bibliometrics in research: Citation Research, Science Citation Index. Patent: definition, types and Indian Patent Act.

UNIT IV **(12 Hours)**

Interpretation of Data and Paper Writing: Types of manuscript in journals. Layout of a Research paper and proof correction. Journals in Life Science, Impact factor of Journals, Software for paper formatting like LaTeX/MS Office, BEAMER for presentation.

UNIT V **(12 Hours)**

Structure of thesis. Literature collection: Books, Research articles and e- resources. Structure and components of research proposal, National and International funding sources. Ethical issues related to publishing. Plagiarism and Software for detection of Plagiarism.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Kothari, C. R. (2014). *Research Methodology- Methods & Techniques*. Wishwa Prakashan
2. Misra, R. P. (2000). *Research Methodology-A Hand book*. Concept Pub. Company.
3. Pillai., & Bagavathi. (2008). *Statistics*. S. Chand &CompanyLtd.

Books for Reference:

1. Gupta, S. P. (1990). *Statistical Methods.* SultanChand&Sons.
2. Rao, N. G. (1983). *Statistics for Agricultural Science.*Oxford&IBH.
3. Gupta, S. C. (2013). *Fundamentals of statistics*. Himalaya Publishers.

Websites and eLearning Sources:

1. https://www.trueeditors.com/blog/components-of-a-thesis/
2. https://www.aresearchguide.com/4format.html

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Understand and comprehend the basics in research methodology and Applying the min research/project work.	**K1**
CO2	Demonstrate the ability to choose methods appropriate to research objectives.	**K2**
CO3	develop advanced critical thinking skills and Demonstrate enhanced writing skills	**K3**
CO4	Help them to select an appropriate research design	**K4**
CO5	Enable them to collect the data, edit it properly and analyse it accordingly. Thus, it will facilitate students' prosperity in higher education.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT53ES02A**			**Discipline Specific Elective - 2:** Research Methodology						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	2	3	2	2	1	**2.2**
CO3	2	2	3	2	1	3	3	2	3	1	**2.2**
CO4	3	3	2	3	1	3	3	2	3	1	**2.4**
CO5	2	2	2	2	1	2	2	2	2	1	**1.8**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT53ES02B	**Discipline Specific Elective - 2:** Cell Signaling	4	3

Course Objectives
To introduce the fundamental concepts of cell signaling, including types of signaling pathways and their significance in cellular communication.
To explore various signal transduction mechanisms, including receptor-ligand interactions, second messengers, and intracellular signaling molecules.
To understand the role of major signaling pathways such as GPCR, RTKs, MAPK, and JAK-STAT in cellular function and disease.
To analyze the impact of cell signaling in physiological and pathological conditions, including cancer, immune responses, and neurological disorders.
To provide insights into modern techniques used in cell signaling research, including imaging, molecular biology, and bioinformatics approaches.

UNIT I **(12 Hours)**

Introduction to Cell Signaling: Overview of cell signaling: Definition, types, and importance, Autocrine, paracrine, endocrine, and juxtacrine signaling, Components of a signaling pathway: Ligands, receptors, secondary messengers, and effectors.

UNIT II **(12 Hours)**

Receptors and Their Mechanisms: G-protein coupled receptors (GPCRs): Structure, function, and signaling cascades, Receptor tyrosine kinases (RTKs): Activation and downstream pathways, Cytokine receptors and JAK-STAT signaling. Ion-channel linked receptors and neurotransmitter signaling.

UNIT III **(12 Hours)**

Second Messengers and Signal Transduction: Role of cyclic AMP (cAMP), cyclic GMP (cGMP), Ca^{2+}, and IP_3 in signaling, Protein kinases and phosphatases in signal amplification, MAP kinase (MAPK) pathway and its role in cell proliferation and differentiation, PI3K-Akt signaling and its significance in cell survival.

UNIT IV **(12 Hours)**

Cell Signaling in Health and Disease: Role of signaling pathways in apoptosis and cell cycle regulation, signaling mechanisms in immune response (T-cell and B-cell activation), Oncogenic signaling and cancer (p53, Ras, and Myc pathways) Neurotransmitter signaling and neurological disorders.

UNIT V **(12 Hours)**

Techniques in Cell Signaling Research: Fluorescence microscopy and live-cell imaging in signaling studies, Western blotting and immunoprecipitation for protein interaction analysis, CRISPR and RNA interference (RNAi) in studying signaling pathways, Computational modeling and bioinformatics approaches in signaling.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Lodish, H., Berk, A., Kaiser, C. A., et al.(2021). *Molecular Cell Biology (9th Edition)*. W.H. Freeman and Company**.**
2. Alberts, B., Johnson, A., Lewis, J., et al. (2022). Molecular Biology of the Cell (7th Edition). Garland Science**.**
3. Cooper, G. M., & Hausman, R. E. (2019). The Cell: A Molecular Approach (8th Edition). Sinauer Associates (Oxford University Press)**.**

Books for Reference:

1. Raven, P. H., Johnson, G. B., Mason, K. A., et al. (2020). Biology (12th Edition). McGraw-Hill Education**.**
2. Karp, G. (2018). Cell and Molecular Biology: Concepts and Experiments (8th Edition). John Wiley & Sons**.**

3. Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th Edition). Macmillan Learning.
4. Berg, J. M., Tymoczko, J. L., Gatto, G. J., &Stryer, L. (2022). Biochemistry (9th Edition).W.H. Freeman and Company.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC4968160/pdf/cshperspect-SIG-a005926.pdf
2. https://www.ncbi.nlm.nih.gov/books/NBK11002/
3. https://www.ncbi.nlm.nih.gov/books/NBK9924/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Describe the fundamental principles of cell signaling, including different signaling pathways and their physiological relevance.	**K1**
CO2	Explain the molecular mechanisms of signal transduction, including receptor activation, secondary messengers, and intracellular signaling cascades.	**K2**
CO3	Analyze key signaling pathways and their roles in cell proliferation, immune response, and apoptosis.	**K3**
CO4	Interpret the implications of defective signaling pathways in diseases such as cancer, immune disorders, and neurological conditions.	**K4**
CO5	Apply modern techniques for studying cell signaling, including imaging, protein interaction analysis, and molecular biology tools.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
5	**25UBT53ES02B**		**Discipline Specific Elective - 2:** Cell Signaling							**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	1	2	2	3	2	1	2	**2.1**
CO2	2	3	2	2	2	2	3	2	2	3	**2.3**
CO3	2	2	3	2	1	2	2	3	2	2	**2.1**
CO4	1	2	2	3	2	2	3	2	3	2	**2.2**
CO5	1	2	2	3	2	2	3	2	1	3	**2.1**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT54OE01	**Open Elective - 1 (WS):** Traditional Medicine and Natural Products	4	2

Course Objectives
To introduce students to the fundamental concepts of traditional medicine systems, including Ayurveda, Siddha, Unani, and other indigenous practices in India.
To explore the role of medicinal plants and natural productsin healthcare and biotechnology.
To understand the biochemical and pharmacological properties of bioactive compounds derived from natural sources.
To analyze the scientific validation of traditional medicines and their integration with modern biotechnological approaches.
To study the regulatory, ethical, and commercial aspects of natural products in the pharmaceutical and biotechnology industries.

UNIT I **(12 Hours)**

Introduction to Traditional Medicine: Overview of traditional medicine: Definition, scope, and importance, Indian traditional systems: Ayurveda, Siddha, Unani, and Homeopathy, Traditional knowledge and its relevance in modern healthcare, World traditional medicine systems: Traditional Chinese Medicine (TCM), Kampo, and African Herbal Medicine.

UNIT II **(12 Hours)**

Medicinal Plants and Their Uses: Classification of medicinal plants and their therapeutic importance, Active compounds from plants: Alkaloids, flavonoids, terpenoids, polyphenols, Ethnobotany and the role of indigenous knowledge in drug discovery, Herbal formulations and their applications in disease management

UNIT III **(12 Hours)**

Natural Products and Their Biotechnological Applications: Natural product sources: Plants, microbes, and marine organisms, Extraction, purification, and characterization of bioactive compounds, Role of natural products in antimicrobial, anticancer, and immunomodulatory therapies, Biotechnological approaches in natural product enhancement

UNIT IV **(12 Hours)**

Pharmacology and Toxicology of Natural Products: Mechanism of action of plant-derived drugs, Pharmacokinetics and pharmacodynamics of herbal medicines, Adverse effects, toxicity, and herb-drug interactions, Methods of evaluating the efficacy and safety of natural products

UNIT V **(12 Hours)**

Traditional Medicine in Modern Drug Discovery: Reverse pharmacology and bioprospecting of medicinal plants, Role of biotechnology in improving the bioavailability of herbal drugs, Use of genetic engineering in medicinal plant research, Nanotechnology applications in herbal drug delivery. Quality control and standardization of herbal medicines, Regulations governing herbal and natural products (AYUSH, WHO, FDA), Intellectual property rights (IPR) and patents in traditional medicine, Ethical concerns and sustainability in the use of natural resources

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Trease, G. E., & Evans, W. C. (2019). *Trease and Evans' Pharmacognosy (16th Edition)*. Elsevier Health Sciences.
2. Mukherjee, P. K. (2022). *Quality Control and Evaluation of Herbal Drugs (2nd Edition)*. Elsevier**.**
3. Mishra, L. C. (2019). *Scientific Basis for Ayurvedic Therapies*. CRC Press.

Books for Reference:

1. Tyler, V. E., Brady, L. R., & Robbers, J. E. (2021). *Pharmacognosy (9th Edition)*. Wolters Kluwer.
2. Kumar, N. C. (2021). *Biotechnological Approaches to Herbal Medicine Research*. Springer.

3. Pandey, M. M., Rastogi, S., & Rawat, A. K. S. (2020). *Indian Medicinal Plants: An Illustrated Dictionary (2nd Edition)*. Springer.
4. WHO Monographs on Selected Medicinal Plants (2009-2021). *World Health Organization Publications*.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC9599697/pdf/biomolecules-12-01442.pdf
2. https://niasm.icar.gov.in/sites/default/files/pdfs/31-Medicinal-handbook.pdf
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC2507744/pdf/nihms56735.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the principles and significance of traditional medicine systems, including their history, scope, and relevance in modern healthcare.	**K1**
CO2	Identify key medicinal plants and their bioactive compounds, understanding their pharmacological importance.	**K2**
CO3	Demonstrate knowledge of biotechnological applications in natural product research, including extraction, purification, and bioassays.	**K3**
CO4	Evaluate the efficacy, safety, and toxicity of herbal medicines, applying scientific methods for validation.	**K4**
CO5	Understand regulatory frameworks, commercialization strategies, and ethical considerations in the field of traditional medicine and natural products.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT54OE01**			**Open Elective - 1 (WS):** Traditional Medicine and Natural Products						**4**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	1	2	3	1	2	3	3	**2.2**
CO3	2	2	2	3	1	2	2	3	2	2	**2.1**
CO4	3	2	2	1	3	3	1	3	2	3	**2.4**
CO5	2	3	2	3	1	3	2	3	2	1	**2.2**
										Mean Overall Score	**2.3 (Medium)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
5	25UBT54SL04	**Certificate Course:** Phytopharmaceuticals	-	2

Course Objectives
To introduce the fundamentals of phytopharmaceuticals, including their classification, sources, and importance in modern medicine.
To explore the extraction, isolation, and characterization techniques of bioactive compounds from medicinal plants.
To understand the pharmacological activities and mechanisms of action of plant-derived drugs.
To analyze the quality control, standardization, and regulatory aspects of herbal drugs and phytopharmaceuticals.
To examine the applications of phytopharmaceuticals in healthcare, including drug formulation, safety assessment, and commercialization.

UNIT I

Introduction to Phytopharmaceuticals: Definition, scope, and significance of phytopharmaceuticals, Sources of plant-derived pharmaceuticals: Herbs, shrubs, and trees; Classification of phytochemicals: Alkaloids, flavonoids, terpenoids, polyphenols, glycosides; Traditional medicine systems and their relationship with phytopharmaceuticals (Ayurveda, Siddha, Unani, Traditional Chinese Medicine)

UNIT II

Extraction, Isolation, and Characterization of Phytochemicals: Methods of extraction: Maceration, percolation, Soxhlet extraction, supercritical fluid extraction Isolation and purification techniques: Chromatography (TLC, HPLC, GC-MS, LC-MS), spectroscopy (UV, IR, NMR), Factors affecting phytochemical yield and bioavailability, Green chemistry approaches for sustainable phytopharmaceutical production

UNIT III

Pharmacology and Therapeutic Applications of Phytopharmaceuticals: Mechanisms of action of plant-derived drugs, Pharmacokinetics and pharmacodynamics of phytopharmaceuticals, Herbal drugs in disease management: Anticancer, anti-inflammatory, antidiabetic, antimicrobial, and neuroprotective agents; Role of phytopharmaceuticals in functional foods and nutraceuticals

UNIT IV

Quality Control and Regulatory Aspects: Standardization and quality control of herbal drugs, WHO guidelines for herbal drug evaluation, Regulatory frameworks: AYUSH (India), FDA (USA), EMA (Europe), and global standards; Intellectual property rights (IPR), patents, and commercialization of phytopharmaceuticals

UNIT V

Future Prospects and Commercialization of Phytopharmaceuticals: Advances in phytopharmaceutical research and biotechnology, Formulation and drug delivery systems for herbal medicines (liposomes, nanoparticles, transdermal patches), Pharmacovigilance and safety concerns of herbal medicines; Case studies of successful phytopharmaceuticals: Artemisinin, Paclitaxel, Resveratrol, Curcumin.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Trease, G. E., & Evans, W. C. (2019). *Trease and Evans' Pharmacognosy (16th Edition)*. Elsevier Health Sciences.
2. Mukherjee, P. K. (2022). *Quality Control and Evaluation of Herbal Drugs (2nd Edition)*. Elsevier**.**
3. Mishra, L. C. (2019). *Scientific Basis for Ayurvedic Therapies*. CRC Press.

Books for Reference:

1. Tyler, V. E., Brady, L. R., & Robbers, J. E. (2021). *Pharmacognosy (9th Edition)*. Wolters Kluwer.
2. Kumar, N. C. (2021). *Biotechnological Approaches to Herbal Medicine Research*. Springer.

3. Pandey, M. M., Rastogi, S., & Rawat, A. K. S. (2020). *Indian Medicinal Plants: An Illustrated Dictionary (2nd Edition)*. Springer.
4. WHO Monographs on Selected Medicinal Plants (2009-2021). *World Health Organization Publications*.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC5750618/pdf/plants-06-00042.pdf
2. https://repository.unair.ac.id/117009/1/C-26%20Artikel.pdf
3. https://oldweb.dibru.ac.in/wp-content/uploads/2024/04/4_Review_Sarkar-et-al__-CTPR-2023_June-ed-1.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the fundamental concepts and classification of phytopharmaceuticals and their significance in healthcare.	**K1**
CO2	Demonstrate knowledge of extraction, isolation, and characterization techniques used in phytopharmaceutical research.	**K2**
CO3	Analyze the pharmacological properties and mechanisms of action of plant-derived drugs in various disease treatments.	**K3**
CO4	Understand the quality control, standardization, and regulatory requirements for herbal drug formulations.	**K4**
CO5	Evaluate the potential of phytopharmaceuticals for commercialization and future applications in biotechnology and medicine.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
5	**25UBT54SL04**			**Certificate Course:** Phytopharmaceuticals						**-**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	2	2	2	2	2	**2.2**
CO2	2	3	2	1	2	3	1	2	3	3	**2.2**
CO3	2	2	2	3	1	2	2	3	2	2	**2.1**
CO4	3	2	2	1	3	3	1	2	2	2	**2.2**
CO5	2	3	2	3	1	3	2	3	2	1	**2.2**
										Mean Overall Score	**2.18 (Medium)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63CC12	**Core Course - 12:** Plant Biotechnology	6	5

Course Objectives
Comprehend the principles, scope, and applications of plant biotechnology.
Gain hands-on experience in plant tissue culture techniques such as micropropagation, callus culture, somatic embryogenesis, and protoplast culture for crop improvement.
Learn various gene transfer methods (*Agrobacterium*-mediated, biolistics, electroporation) and the role of genetic markers in developing genetically modified (GM) crops.
Understand the production of plant-based pharmaceuticals, secondary metabolites, biofortified crops, and their applications in agriculture, medicine, and industry.
Explore emerging technologies like CRISPR-Cas9 genome editing, RNA interference (RNAi), biofortification, and stress resistance strategies to address global agricultural and environmental challenges.

UNIT I **(18 Hours)**

Introduction to Plant Biotechnology: Scope and importance of plant biotechnology, History and applications of plant tissue culture, Concepts of totipotency, differentiation, and dedifferentiation, Laboratory organization and sterilization techniques, Types of culture: callus, suspension, meristem, embryo, anther, and protoplast culture, Applications of tissue culture in crop improvement

UNIT II **(18 Hours)**

Plant Genetic Engineering: Genetic modification of plants and their applications, Gene transfer methods: Agrobacterium-mediated gene transfer, particle bombardment, electroporation, DNA markers in plant biotechnology (RAPD, RFLP, AFLP, SSR, SNP), Genetically Modified (GM) crops: Bt cotton, Golden rice, virus-resistant crops, Ethical concerns and regulatory aspects of GM crops

UNIT III **(18 Hours)**

Plant Tissue Culture and Micropropagation: Principles of plant tissue culture, Nutritional requirements and preparation of media (MS, B5, Nitsch), Micropropagation techniques and its advantages, Somatic embryogenesis and organogenesis, Somaclonal variation and its significance in crop improvement, Applications of micropropagation in forestry and horticulture

UNIT IV **(18 Hours)**

Plant Secondary Metabolites and Industrial Applications: Concept of primary and secondary metabolites**,** Production of medicinal and aromatic plant compounds through biotechnology, Biotechnological approaches for plant-based pharmaceuticals, Bioreactor-based production of secondary metabolites

UNIT V **(18 Hours)**

Advances in Plant Biotechnology: Molecular farming: production of vaccines and therapeutic proteins in plants, RNA interference (RNAi) technology and gene silencing in plants, CRISPR-Cas9 applications in plant genome editing, Stress tolerance in plants (drought, salt, and pest resistance), Biofortification and plant-based edible vaccines, Role of bioinformatics in plant genomics.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd, New Delhi.
2. Chawla. H. S., 2010. Introduction to plant biotechnology. Oxford and IBH publishing company pvt. Ltd, New delhi.
3. Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers.
4. Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, Oxford University Press, USA.

Books for Reference:

1. M.Sudhir. 2000. Applied Biotechnology & Plant Genetics. Dominant publishers & Distributors.

2. Genetic Engineering of Animals by (Ed) A. Puhler, VCH Publishers, Weinheim, FRG, 1993.
3. Animal Cell culture Practical approach. Ed. John R.W. Masters, Oxford.2004.
4. Concepts in Biotechnology D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman Univ. Press, 1996

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC9606719/pdf/fpls-13-1009395.pdf
2. http://eagri.org/eagri50/GPBR311/lec07.pdf 3
3. https://www.frontiersin.org/research-topics/51075/pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the fundamental principles and applications of plant biotechnology, including tissue culture techniques and their role in crop improvement.	**K1**
CO2	Demonstrate knowledge of plant genetic engineering techniques, including gene transfer methods and the development of genetically modified (GM) crops.	**K2**
CO3	Apply plant tissue culture and micropropagation techniques for large-scale plant production and conservation of plant biodiversity.	**K3**
CO4	Analyze the production and industrial applications of plant secondary metabolites, including their use in pharmaceuticals and bioreactors.	**K4**
CO5	Evaluate recent advances in plant biotechnology, including genome editing, molecular farming, and stress tolerance mechanisms in plants.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
6	**25UBT63CC12**		**Core Course - 12:** Plant Biotechnology							**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	2	3	1	2	3	**2.1**
CO2	2	2	3	1	2	3	2	2	3	2	**2.2**
CO3	1	3	2	2	3	1	2	3	2	3	**2.2**
CO4	2	3	2	3	1	2	3	1	2	3	**2.3**
CO5	1	3	3	2	2	2	3	2	1	3	**2.2**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63CC13	**Core Course - 13:** Animal Biotechnology	6	4

Course Objectives
To provide fundamental knowledge of animal biotechnology, including cell culture techniques and genetic engineering.
To explore the principles and applications of transgenic technology, cloning, and gene editing in animals.
To understand the role of biotechnology in animal health and disease diagnosis, including vaccine development and therapeutic proteins.
To analyze ethical, regulatory, and biosafety aspects of animal biotechnology and its impact on society.
To study advancements in reproductive biotechnology, stem cell technology, and their applications in biomedical research and agriculture.

Unit I **(18 Hours)**

Introduction to Animal Biotechnology: Scope and significance of animal biotechnology, Structure and organization of animal cells, Principles of animal cell and tissue culture, Media preparation and sterilization techniques, Primary and secondary cell culture, cell lines, and organ culture, Applications of animal cell culture in research and industry.

UNIT II **(18 Hours)**

Genetic Engineering and Transgenic Technology: Gene cloning and recombinant DNA technology in animals, Methods of gene transfer: Microinjection, electroporation, liposome-mediated transfer, viral vectors, Production and applications of transgenic animals (mice, fish, cattle, sheep, and pigs), CRISPR-Cas9 and other genome-editing tools in animal biotechnology, Applications of gene therapy in animals

UNIT III **(18 Hours)**

Animal Cloning and Reproductive Biotechnology: Principles of cloning and somatic cell nuclear transfer (SCNT), Cloning of animals: Case studies (Dolly the sheep, CC the cat), Artificial reproductive technologies (ARTs): IVF, embryo transfer, cryopreservation, and surrogacy, Embryonic and adult stem cells: Characteristics and therapeutic applications, Role of biotechnology in livestock improvement and conservation of endangered species.

UNIT IV **(18 Hours)**

Animal Health, Disease Diagnosis, and Biopharmaceuticals: Diagnosis of animal diseases using molecular techniques (PCR, ELISA, Microarrays), Production of vaccines and monoclonal antibodies for veterinary use, Recombinant proteins and therapeutic drugs from animal biotechnology (insulin, growth hormones, interferons), Gene therapy for inherited animal diseases, Biopharming: Animals as bioreactors for pharmaceutical production.

UNIT V **(18 Hours)**

Ethical, Regulatory, and Commercial Aspects of Animal Biotechnology: Ethical concerns in animal biotechnology (animal welfare, genetic manipulation, patenting), Biosafety regulations and guidelines (ICMR, DBT, CPCSEA, OECD), Intellectual Property Rights (IPR) and patenting of biotechnological inventions, Commercialization and future prospects of animal biotechnology, Role of bioinformatics in animal genome analysis.

Teaching Methodology	Chart, PPT, Chalk andTalk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Ranga, M. M., 2010. Principles of Animal Biotechnology. Student Edition, New Delhi.
2. National Research Council, 2002. Animal Biotechnology: Science-Based Concerns. National Academies Press, Washington, D.C.
3. Masters, J. R. W., 2000. Animal Cell Culture: A Practical Approach. Oxford University Press, Oxford.
4. Glick, B. R., & Pasternak, J. J., 2017. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, D.C.

Books for Reference:

1. Brown, T. A., 2020. Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell, Hoboken.
2. Maji, A., & Gangopadhyay, K., 2021. CRISPR-Cas: Principles, Practices, and Perspectives. Springer, Singapore.
3. Gordon, I., 2003. Reproductive Biotechnology in Animals. CABI Publishing, Wallingford.
4. Masters, J. R. W., & Masters, L. F., 2017. Stem Cells: Scientific Facts and Fiction. Academic Press (Elsevier), London.

Websites and eLearning Sources:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC10169938/pdf/43141_2023_Article_502.pdf
2. https://www.ncbi.nlm.nih.gov/books/NBK207574/pdf/Bookshelf_NBK207574.pdf
3. https://www.ncbi.nlm.nih.gov/books/NBK223962/pdf/Bookshelf_NBK223962.pdf

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Explain the fundamental principles of animal biotechnology and their applications in research, medicine, and industry.	**K1**
CO2	Demonstrate knowledge of transgenic technology and genetic engineering techniques used in animal biotechnology.	**K2**
CO3	Analyze the role of reproductive and cloning technologies in animal breeding, conservation, and biomedical applications.	**K3**
CO4	Apply biotechnological approaches for animal health improvement, including disease diagnosis, vaccine production, and gene therapy.	**K4**
CO5	Evaluate ethical, biosafety, and regulatory aspects of animal biotechnology and its impact on society and industry.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
6	**25UBT63CC13**			**Core Course – 13:** Animal Biotechnology					**6**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	2	3	1	2	3	**2.1**
CO2	2	2	3	1	2	3	2	2	3	2	**2.2**
CO3	2	3	2	2	3	1	2	3	2	3	**2.3**
CO4	2	3	2	3	1	2	3	1	2	3	**2.3**
CO5	2	3	3	2	2	2	3	2	1	3	**2.3**
Mean Overall Score											**2.24 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63CP06	**Core Practical - 6:** Plant Biotechnology	3	1

Course Objectives
To familiarize students with the fundamental techniques of plant tissue culture**,**
To develop hands-on skills in callus induction and micropropagation techniques**,** enabling students to propagate plants using various explants.
To provide practical knowledge on protoplast isolation, viability testing, and somatic embryogenesis**,** emphasizing their applications in plant biotechnology.
To introduce students to molecular techniques such as DNA extraction, PCR amplification, and restriction digestion**,** essential for plant genetic studies.
To equip students with analytical techniques for plant identification and secondary metabolite quantification**,** including RAPD, RFLP marker analysis, and chromatography methods.

1. Preparation of plant tissue culture media (MS/B5 medium)
2. Callus induction from plant explants (leaf, stem, root)
3. Micropropagation techniques using nodal explants
4. Protoplast isolation and viability testing
5. Somatic embryogenesis and organogenesis observation
6. Agrobacterium-mediated gene transfer in plants
7. DNA extraction from plant tissues and PCR amplification
8. Restriction digestion and electrophoresis of plant DNA
9. RAPD and RFLP marker analysis for plant identification
10. Quantification of secondary metabolites using chromatography (TLC/HPLC)

Teaching Methodology	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Methodology	Result submission and Viva

Books for Study:

1. Plant Tissue Culture: Techniques and Experiments, Roberta H. Smith, 2012 (3rd Edition), Academic Press.
2. Plants from Test Tubes: An Introduction to Micro propagation, Lydiane Kyte, John Kleyn, and Holly Scoggins, 2008 (4th Edition), Timber Press
3. Plant Tissue Culture: Theory and Practice, Sant S. Bhojwani and M. K. Razdan, 1996, Elsevier Science.

Books for Reference:

1. Molecular Cloning: A Laboratory Manual, Michael R. Green and Joseph Sambrook, 2012 (4th Edition), Cold Spring Harbor Laboratory Press.
2. DNA Markers: Protocols, Applications, and Overviews, Gustavo Caetano-Anollés and Peter M. Gresshoff, 1997, Wiley-Liss.

Website and eLearning Resources:

1. https://www.youtube.com/watch?v=U45CuHPDN6c
2. https://www.youtube.com/watch?v=dFrx-t5J0PA
3. https://www.youtube.com/watch?v=ED33jNKGzWk
4. https://www.youtube.com/watch?v=example6

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, the students will be able to	**Cognitive Levels (K-Level)**
CO1	Prepare and optimize plant tissue culture media for *in vitro* culture and understand their role in plant growth.	**K1**
CO2	Successfully induce callus formation and perform micropropagation techniques using different plant explants.	**K2**
CO3	Isolate viable protoplasts and differentiate between somatic embryogenesis and organogenesis, demonstrating their applications in plant tissue culture.	**K3**
CO4	Perform DNA extraction, PCR amplification, and restriction digestion, followed by electrophoretic analysis for genetic studies.	**K4**
CO5	Apply molecular marker techniques (RAPD and RFLP) for plant identification and use chromatography (TLC/HPLC) to quantify secondary metabolites in plants.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
6	**25UBT63CP06**			**Core Practical - 6:** Plant Biotechnology						**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
									Mean Overall Score		**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63CP07	**Core Practical - 7:** Animal Biotechnology	3	1

Course Objectives
To introduce students to fundamental DNA isolation techniques from various animal tissues, including liver, blood, and cheek cells, for genetic analysis.
To develop expertise in cytogenetic techniques, particularly G-banding for karyotyping and chromosomal abnormality detection.
To provide hands-on experience in immunological assays, including ELISA and radial immunodiffusion, for detecting and quantifying proteins and antibodies in animal serum.
To train students in antigen-antibody interaction techniques, such as hemagglutination and hemolysis assays, for immunological studies.
To enhance students' ability to apply molecular and immunological techniques in research and diagnostics related to animal biotechnology.

1. Isolation of genomic DNA from chicken liver cells.
2. Isolation of genomic DNA from chicken blood.
3. Isolation of genomic DNA from human check cells.
4. G-banding technique for karyotyping and chromosomal abnormalities detection.
5. Enzyme-Linked Immunosorbent Assay (ELISA): Detection of specific antigens or antibodies in animal serum.
6. Radial Immunodiffusion Assay: Quantification of specific proteins in serum samples.
7. Hemagglutination and Hemolysis Assay: Study of antigen-antibody interactions in red blood cells.

Teaching Methods	Lectures, Practical experiments, Group discussions, Demonstrations.
Assessment Method	Result submission and Viva

Books for Study:

1. Molecular Cloning: A Laboratory Manual, Michael R. Green and Joseph Sambrook, 2012 (4th Edition), Cold Spring Harbor Laboratory Press.
2. Current Protocols in Molecular Biology, Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, and Kevin Struhl, 1987, John Wiley & Sons.
3. Human Chromosomes, Orlando J. Miller and Eeva Therman, 2001 (4th Edition), Springer.

Books for Reference:

1. The ELISA Guidebook, John R. Crowther, 2009 (2nd Edition), Humana Press.
2. Medical Microbiology, F. H. Kayser, K. A. Bienz, J. Eckert, and R. M. Zinkernagel, 2005, Thieme

Website and eLearning Resources:

1. https://www.youtube.com/watch?v=YGeBCn7pVaA
2. https://www.youtube.com/watch?v=example2
3. https://www.youtube.com/watch?v=example3
4. https://www.youtube.com/watch?v=example5

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Isolate and analyze genomic DNA from different animal for molecular studies.	**K1**
CO2	Perform karyotyping using the G-banding technique and interpret chromosomal abnormalities in animal cells.	**K2**
CO3	Conduct immunoassays like ELISA and radial immunodiffusion to detect and quantify antigens and antibodies in biological samples.	**K3**
CO4	Apply hemagglutination and hemolysis assays to study antigen-antibody interactions and immune responses.	**K4**
CO5	Utilize molecular and immunological techniques in biotechnology research and diagnostics, contributing to advancements in animal health and genetics.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
6	**25UBT63CP07**			**Core Practical - 7:** Animal Biotechnology						**3**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	3	2	**2.4**
CO2	2	2	3	2	3	3	2	3	2	2	**2.3**
CO3	2	3	2	3	2	2	3	2	3	2	**2.4**
CO4	2	2	3	2	3	3	2	3	2	3	**2.5**
CO5	2	2	2	3	2	2	2	3	2	2	**2.2**
									Mean Overall Score		**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63ES03A	**Discipline Specific Elective - 3:** Molecular Diagnostics	4	3

Course Objectives
To introduce the principles and techniques of molecular diagnostics.
To understand the role of nucleic acid-based methods in disease diagnosis.
To explore immunodiagnostic techniques and their applications.
To study advanced diagnostic tools such as next-generation sequencing (NGS) and bioinformatics.
To gain knowledge of molecular diagnostic applications in infectious diseases, genetic disorders, and cancer.

UNIT I **(12 Hours)**

Introduction to Molecular Diagnostics: Scope and importance of molecular diagnostics, Biomarkers in disease detection, Sample collection, storage, and handling for molecular diagnosis, Quality control and biosafety measures in molecular diagnostics laboratories.

UNIT II **(12 Hours)**

Nucleic Acid-Based Diagnostics: DNA and RNA extraction methods, Polymerase Chain Reaction (PCR) and its variants (qPCR, RT-PCR, Multiplex PCR, Droplet Digital PCR), Nucleic acid hybridization techniques: Southern blotting, Northern blotting, and microarrays, CRISPR-based diagnostics and their emerging applications.

UNIT III **(12 Hours)**

Immunodiagnostic Techniques: Principle and applications of ELISA, Western blotting, and Immunofluorescence assays, Monoclonal and polyclonal antibodies in diagnostics, Flow cytometry and its role in disease detection, Biosensors for molecular diagnostics.

UNIT IV **(12 Hours)**

Advanced Molecular Diagnostic Techniques: Next-Generation Sequencing (NGS) and Whole Genome Sequencing (WGS), Microfluidics and lab-on-a-chip technologies, Bioinformatics tools for sequence analysis and disease prediction, Point-of-care testing (POCT) and rapid molecular diagnostics.

UNIT V **(12 Hours)**

Applications of Molecular Diagnostics: Diagnosis of infectious diseases (COVID-19, Tuberculosis, HIV, HPV, Hepatitis), Genetic disorder screening (Cystic Fibrosis, Sickle Cell Anemia, Thalassemia), Cancer biomarkers and molecular oncology diagnostics, Pharmacogenomics and personalized medicine, Ethical and regulatory considerations in molecular diagnostics.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Methodology	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications – Lela Buckingham & Maribeth Flaws, 3rd Edition, 2018, F.A. Davis Company.
2. Molecular Diagnostic PCR Handbook – Gerrit J. Viljoen & Mohammad Monne, 2005, Springer.
3. Principles of Molecular Diagnostics and Personalized Cancer Medicine – Dongfeng Tan & Henry T. Lynch, 2013, Lippincott Williams & Wilkins.

Books for Reference:

1. Molecular Biology of the Cell – Alberts B. et al., 6th Edition, 2014, Garland Science.
2. Clinical Chemistry and Molecular Diagnostics – Nader Rifai, 7th Edition, 2018, Elsevier.
3. Molecular Diagnostics for the Clinical Laboratorian – William B. Coleman & Gregory J. Tsongalis, 2nd Edition, 2006, Humana Press.

Websites and eLearning Sources:

1. https://link.springer.com/content/pdf/10.1007/s11684-012-0195-5.pdf

2. https://www.lecturio.com/blog/immunodiagnostics-introduction-and-methods/
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC10086565/pdf/mmr-27-05-12991.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Understand the principles and applications of molecular diagnostics in disease detection.	**K1**
CO2	Perform nucleic acid extraction, PCR, and hybridization techniques.	**K2**
CO3	Apply immunodiagnostic techniques for disease identification.	**K3**
CO4	Explore advanced diagnostic tools like NGS and bioinformatics.	**K4**
CO5	Evaluate the role of molecular diagnostics in infectious diseases, cancer, and genetic disorders.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
6	**25UBT63ES03A**			**Discipline Specific Elective - 3:** Molecular Diagnostics						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	2	3	2	2	1	**2.2**
CO3	2	2	3	2	3	3	3	2	3	2	**2.4**
CO4	3	3	2	3	1	3	3	2	3	1	**2.4**
CO5	2	2	2	2	2	2	2	2	2	2	**2.0**
Mean Overall Score											**2.28 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63ES03B	**Discipline Specific Elective - 3:** Biostatistics	4	3

Course Objectives
To understand the basic concepts of biostatistics and its applications in biological sciences.
To learn different types of data, statistical distributions, and data visualization techniques.
To apply statistical methods for hypothesis testing, correlation, and regression analysis.
To explore the role of probability and statistical inference in biotechnology research.
To develop skills in using statistical tools for data analysis in life sciences.

UNIT I **(12 Hours)**

Introduction to Biostatistics: Definition, scope, and applications of biostatistics in biotechnology, Types of data: qualitative and quantitative, Data collection, classification, and tabulation, Measures of central tendency: mean, median, mode, Measures of dispersion: range, variance, standard deviation, coefficient of variation.

UNIT II **(12 Hours)**

Probability and Distributions: Introduction to probability and probability theorems, Types of probability distributions: Binomial, Poisson, Normal distribution, Concept of sampling and sampling methods, Standard error and confidence intervals, Applications of probability in biological studies.

UNIT III **(12 Hours)**

Hypothesis Testing and Statistical Inference: Concept of hypothesis and types of errors, Parametric and non-parametric tests, Student's t-test, Chi-square test, ANOVA (one-way and two-way), P-value and significance testing, Applications of hypothesis testing in biological research.

UNIT IV **(12 Hours)**

Correlation, Regression, and Experimental Design: Correlation analysis: Pearson's and Spearman's correlation coefficient, Regression analysis: simple and multiple regression, Design of experiments: randomized block design (RBD), completely randomized design (CRD), Latin square design, Applications in biotechnology research and clinical studies.

UNIT V **(12 Hours)**

Statistical Software and Bioinformatics Applications: Introduction to statistical software: SPSS, R, and Excel, Data visualization techniques: histograms, box plots, scatter plots, Use of biostatistics in genomics, proteomics, and clinical trials, Interpretation and presentation of statistical results.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Biostatistics: A Foundation for Analysis in the Health Sciences – Wayne W. Daniel & Chad L. Cross, 10th Edition, 2018, Wiley.
2. Principles of Biostatistics – Marcello Pagano & Kimberlee Gauvreau, 2nd Edition, 2000, CRC Press.
3. Fundamentals of Biostatistics – Bernard Rosner, 8th Edition, 2015, Cengage Learning.

Books for Reference:

1. Biostatistics for the Biological and Health Sciences – Marc M. Triola & Mario F. Triola, 2nd Edition, 2018, Pearson.
2. Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking – Harvey Motulsky, 4th Edition, 2017, Oxford University Press.
3. Biostatistical Analysis – Jerrold H. Zar, 5th Edition, 2010, Pearson.

Websites and eLearning Sources:

1. https://www.datasciencecentral.com/an-introduction-to-statistical-inference-and-hypothesis-testing/
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC374386/pdf/cc2401.pdf

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Understand the fundamental concepts of biostatistics and their applications in biological sciences.	**K1**
CO2	Apply statistical measures to analyze biological data effectively.	**K2**
CO3	Perform hypothesis testing, correlation, and regression analysis.	**K3**
CO4	Use probability theory and statistical inference in life science research.	**K4**
CO5	Utilize statistical software for data analysis and visualization in biotechnology applications.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
6	**25UBT63ES03B**		**Discipline Specific Elective - 3:** Biostatistics							**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	3	2	**2.4**
CO2	2	3	2	3	2	2	3	2	2	1	**2.2**
CO3	2	2	3	2	3	3	3	2	3	2	**2.4**
CO4	3	3	2	3	1	3	3	2	3	1	**2.4**
CO5	2	2	1	2	1	2	2	1	2	1	**1.6**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63ES04A	**Discipline Specific Elective - 4:** Pharmaceutical Biotechnology	4	3

Course Objectives
Define the scope of pharmaceutical biotechnology, classify pharmacological agents, and explain drug absorption, metabolism, and excretion mechanisms.
Explore different classes of phytopharmaceuticals, extraction techniques, phytochemical screening, and advanced analytical tools (TLC, HPTLC, GC, HPLC, NMR, Mass spectrometry) used in drug discovery.
Understand the classification, mechanism, and resistance of antibiotics, and perform antimicrobial activity studies along with in-vitro and in-vivo pharmacological assays.
Gain insights into drug development stages, including target identification, lead optimization, clinical trials, regulatory approvals, and ethical guidelines for drug testing.
Study the principles of vaccine production, types of vaccines, recombinant proteins, probiotics, nutraceuticals, and the economic and legal aspects of pharmaceutical biotechnology.

UNIT- I **(12 Hours)**

Introduction to Pharmaceutical Biotechnology: Definition and scope of Pharmaceutical Biotechnology, sources of drugs, classification of pharmacological agents (based on chemistry, mode of action, dosage forms), route of administration, absorption and bioavailability of drugs, distribution and liver detoxification metabolism and drug excretion.

UNIT- II **(12 Hours)**

Phytopharmaceuticals: General classes and properties of phytopharmaceuticals, Extraction of phytochemicals, Phytochemical screening of medicinal plants. Bioassay guided fractionation methodsTLC, HPTLC, GC, and HPLC, Role of NMR and Mass spectrometry in drug discovery.

UNIT- III **(12 Hours)**

Antimicrobial agents and Antibiotics: source, classification, mode of action, Antimicrobial resistance, and Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activity). Pharmacological Assays – *In vitro* assays - chemical (anti-oxidant), Biological (anticancerous and assay system based on enzymes and cells), and immunological (RIA and ELISA) - *In vivo* assays (Anti-inflammatory and Anti-analgesic).

UNIT- IV **(12 Hours)**

Process of drug discovery and development: Target identification and validation, Assay development, lead optimization, pre-clinical testing, clinical trials involved in drug discovery and development, regulatory approvals and phase IV trials, High throughput screening, CPCSEA guidelines, ICMR guidelines for drug testing.

UNIT- V **(12 Hours)**

Vaccines: concept, production and types - Inactivated, Attenuated, toxoid, Recombinant vaccines, Peptide and DNA vaccines, Edible vaccines, nanodrugs. Recombinant proteins, approved rDNA drugs in market, Probiotics, Nutraceuticals, Economic and legal considerations in Pharmaceutical Biotechnology

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, Pharmacology and Pharmacotherapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai.
2. Tripathy K. D, Essentials of Medical Pharmacology (6th edition), Jaypee publishers
3. Shoba rani R Hiremath, Text book of industrial pharmacy, orient longman Pvt ltd 2008.
4. Crommelin Daan J. A., Sindelar D. Robert (3rd edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007.

Books for Reference:

1. Trease, G.E.and Evans, W.C., 2011, Pharmacognosy (12th edition), Bailliere Tindall Eastbourne, U.K
2. MukherjeP. K., Quality Control Herbal Drugs–An approach to evaluation of botanicals. Business Horizons Pharmaceutical Publishers, 2005

Websites and eLearning Sources:

1. https://oldweb.dibru.ac.in/wp-content/uploads/2024/04/4_Review_Sarkar-et-al__-CTPR-2023_June-ed-1.pdf
2. https://www.frontiersin.org/journals/drug-discovery/articles/10.3389/fddsv.2023.1201419/pdf
3. https://my.clevelandclinic.org/health/treatments/24135-vaccines

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the definition, scope, and classification of pharmaceutical agents, along with drug absorption, metabolism, and excretion.	**K1**
CO2	Demonstrate knowledge of phytopharmaceutical properties, phytochemical extraction, and screening techniques using chromatography and spectrometry methods.	**K2**
CO3	Describe the classification, mode of action, and resistance mechanisms of antimicrobial agents, and perform in vitro and in vivo pharmacological assays.	**K3**
CO4	Outline the steps in drug discovery, including target identification, assay development, clinical trials, regulatory approvals, and ethical guidelines.	**K4**
CO5	Examine different types of vaccines, recombinant protein drugs, probiotics, nutraceuticals, and the economic and legal considerations in pharmaceutical biotechnology.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
6	**25UBT63ES04A**		**Discipline Specific Elective - 4:** Pharmaceutical Biotechnology						**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	2	2	2	3	2	**2.3**
CO2	2	3	2	3	2	2	3	2	2	1	**2.2**
CO3	2	2	3	2	2	3	3	2	3	2	**2.3**
CO4	3	3	2	2	1	3	3	2	3	1	**2.3**
CO5	2	2	2	2	2	2	2	2	2	1	**1.9**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT63ES04B	**Discipline Specific Elective - 4:** Bioentrepreneurship	4	3

Course Objectives
To introduce students to the concept of bioentrepreneurship, its global scope, and the importance of innovation and entrepreneurship in the biotechnology sector.
To equip students with essential management and financial skills needed for bioentrepreneurship.
To familiarize students with the role of knowledge centers (such as universities and business incubators) in bioentrepreneurship.
To provide students with the knowledge of small and medium-scale industries (SMEs) in biotechnology.
To help students understand the principles of marketing, branding, and market demand analysis for bio-based products.

UNIT I **(12 Hours)**

Introduction to Bioentrepreneurship: Biotechnology in a global scale, Scope in Bioentrepreneurship, Importance of entrepreneurship. Meaning of entrepreneur, function of an entrepreneur, types of entrepreneur, and advantages of being entrepreneur. Innovation – types, out of box thinking, opportunities for Bioentrepreneurship. Entreprenuership development programs of public and private agencies (MSME, DBT, BIRAC, Startup and Make in India). Patent landscape, IP protection and commercialization strategies.

UNIT II **(12 Hours)**

Management, accounting and finance: Management principles of Henry Fayol. Business plan preparation: business feasibility analysis by SWOT, socio-economic costs benefit analysis, Sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, double entry book keeping, and estimation of income, expenditure and Income tax. Collaborations and partnerships, information technology for business administration and expansion.

UNIT III **(12 Hours)**

Knowledge Centre And Research and Development: Knowledge centers - Universities, innovation centre, research institutions and business incubators. R&D - technology development and upgradation, assessment of technology development, managing technology transfer, industry visits to successful bio-enterprises, regulations for transfer of foreign technologies, quality control, technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GLP, GCP & GMP).

UNIT IV **(12 Hours)**

Medium and Small-scale industry: Definition, characteristics, need and rationale, objectives, scope and advantages of small-scale industries. Types of bioindustries – Pharma, Agri and Industry. Biofertilizers production - Azospirillium, Azolla, Cyanobacteria and its applications. Biopecticides production - Bacterial, fungal, viral and plant insecticides. Sericulture. Apiculture. Dairy farming. Single Cell Protein: Production and applications. Vermicomposting and its applications. Mushroom cultivation and its application. Ancillary and tiny industries.

UNIT V **(12 Hours)**

Marketing and Human Resource Development: Assessment of market demand for potential product(s) of interest, Market conditions, segments, prediction of market changes, identifying needs of customers including gaps in the market. Branding issues, developing distribution channels – franchising policies, promotion, advertising, branding and market linkages. Marketing of agro products. Recruitment and selection process, leadership skills, managerial skills, organization structure, training, team building and teamwork.

Teaching Methodology	Chart, PPT, Videos, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

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

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

Books for Reference:

1. Management Fundamentals", Robert Lusier – Concepts, Application, Skill Development" Thomson.
2. Entrepreneurship Development" S SKhanka, S Chand & Co

Websites and eLearning Sources:

1. Entrepreneurship – SWAYAM https://on
2. linecourses.swayam2.ac.in/cec19_mg39/previe

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Know the legal and financial conditions for starting a business venture.	**K1**
CO2	Explain the importance of marketing and management in small businesses venture and can interpret their own business plan.	**K2**
CO3	Able to identify the elements of success of bioentrepreneurial scheme and projects.	**K3**
CO4	Specify the basic performance indicators of various entrepreneurial activities.	**K4**
CO5	Analyse the business environment in order to identify business opportunities.	**K5**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
6	**25UBT63ES04B**		**Discipline Specific Elective - 4:** Bioentrepreneurship							**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	2	3	2	1	2	**2.2**
CO2	2	3	2	2	3	2	3	2	2	1	**2.2**
CO3	2	2	3	2	1	2	2	3	2	2	**2.1**
CO4	1	2	2	3	2	2	3	2	3	2	**2.2**
CO5	2	2	2	3	2	2	3	2	2	3	**2.3**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
6	25UBT64OE02	**Open Elective - 2:** Food Science and Technology	4	2

Course Objectives
To understand the fundamentals of food science, food composition, and nutritional aspects.
To explore food processing and preservation techniques for maintaining food quality and safety.
To study food microbiology, including spoilage, fermentation, and foodborne pathogens.
To learn about food packaging, quality control, and regulatory standards in the food industry.
To introduce innovations in food technology, including functional foods, nutraceuticals, and novel processing methods.

UNIT I **(12 Hours)**

Introduction to Food Science: Scope and importance of food science and technology, Food components: carbohydrates, proteins, lipids, vitamins, and minerals, Water activity and its role in food preservation, Nutritional value and dietary requirements, Food adulteration and detection methods.

UNIT II **(12 Hours)**

Food Processing and Preservation: Principles of food processing and preservation, Thermal processing: pasteurization, sterilization, and canning, Non-thermal processing: irradiation, high-pressure processing (HPP), and pulsed electric fields, Chemical and biological preservatives, Role of enzymes in food processing.

UNIT III **(12 Hours)**

Food Microbiology and Fermentation Technology: Microorganisms in food: beneficial and harmful microbes, Food spoilage and microbial contamination. Foodborne diseases and their prevention, Fermentation technology and production of fermented foods (yogurt, cheese, pickles, wine, etc.), Probiotics and prebiotics in health and nutrition.

UNIT IV **(12 Hours)**

Food Quality, Safety, and Packaging: Principles of food quality control and assurance, HACCP (Hazard Analysis and Critical Control Points) and food safety management systems, Food laws and regulations: FSSAI, FDA, Codex Alimentarius, WHO guidelines, Food packaging materials and their impact on food quality, Smart packaging and nanotechnology in food packaging.

UNIT V **(12 Hours)**

Advances in Food Technology: Functional foods and nutraceuticals, genetically modified foods (GM foods) and biofortification, Novel food processing technologies (3D food printing, cold plasma, ultrasound processing), Sustainable food production and waste management, Future trends in food science and technology.

Teaching Methodology	Chart, PPT, Chalk and talk.
Assessment Method	Quiz, Assignments, MCQs, Seminars

Books for Study:

1. Potter, N. N., & Hotchkiss, J. H., 2012. Food Science. Springer, New York.
2. Manay, S., &Shadaksharaswamy, M., 2008. Foods: Facts and Principles. New Age International Publishers, New Delhi.
3. Fennema, O. R., 2008. Fennema's Food Chemistry. CRC Press, Boca Raton.
4. Belitz, H. D., Grosch, W., & Schieberle, P., 2009.Food Chemistry. Springer, Berlin.
5. Jay, J. M., Loessner, M. J., & Golden, D. A., 2005. Modern Food Microbiology. Springer, New York.

Books for References:

1. Adams, M. R., & Moss, M. O., 2008. Food Microbiology. Royal Society of Chemistry, Cambridge.
2. Prescott, L. M., Harley, J. P., & Klein, D. A., 2002. Microbiology. McGraw-Hill, New York.
3. Parker, R., 2010. Introduction to Food Science. Delmar Cengage Learning, Clifton Park.

Websites and eLearning Sources:

1. https://krishi.icar.gov.in/jspui/bitstream/123456789/82861/1/Chapter%201%20%281-6%29.pdf

2. https://pmc.ncbi.nlm.nih.gov/articles/PMC7823516/pdf/foods-10-00069.pdf
3. https://www.mdpi.com/2227-9717/10/4/747/pdf?version=1649830134

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, the students will be able to	
CO1	Explain the fundamentals of food composition, nutrition, and food safety.	**K1**
CO2	Apply different food processing and preservation techniques to enhance shelf life.	**K2**
CO3	Analyze the role of microorganisms in food spoilage, fermentation, and foodborne diseases.	**K3**
CO4	Evaluate food quality, safety standards, and packaging innovations.	**K4**
CO5	Explore modern advancements in food technology and their applications in the food industry.	**K5**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
6	**25UBT64OE02**			**Open Elective - 1 (BS):** Food Science and Technology						**4**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	2	3	2	2	2	**2.3**
CO2	2	3	2	2	3	2	3	2	2	2	**2.3**
CO3	2	2	3	2	2	2	2	3	2	2	**2.2**
CO4	2	2	2	3	2	1	3	2	3	2	**2.2**
CO5	1	2	2	3	2	2	3	2	2	3	**2.2**
Mean Overall Score											**2.24 (High)**