B.Sc.,
BIOTECHONOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR
2023 - 2024

TAMILNADUSTATECOUNCILFORHIGHER EDUCATION,
CHENNAI – 600005

Semester II	
Semester III	
Semester IV	
Semester V	
Semester VI	
Skill Enhancement courses(NME)	
Skill Enhancement courses (Discipline/Sub/Entrepreneurial)	
Allied (Offered by Biotechnology)	

1. Preamble for B.Sc. Biotechnology Program

Biotechnology, a dynamic discipline bridging life sciences and applied technology, explores biological systems and applies molecular and cellular processes for practical purposes. This field encompasses diverse domains, including genetic engineering, molecular biology, bioinformatics, industrial biotechnology, and environmental biotechnology. Biotechnology has revolutionized scientific discovery, reshaping industries and providing solutions to global challenges.The demand for biotechnologists is steadily increasing across various sectors, such as healthcare, agriculture, pharmaceuticals, environmental conservation, and beyond. Biotechnological innovations have become essential in addressing issues like disease prevention, sustainable food production, and environmental preservation. The Bachelor of Science in Biotechnology (B.Sc. Biotechnology) program is meticulously designed to prepare students for success in this dynamic field.This program envisions nurturing a generation of biotechnologists who possess a deep understanding of the discipline's core principles, methodologies, and ethical considerations. It is committed to equipping students with the knowledge, skills, and ethical values required to drive pioneering solutions and innovations in biotechnology.At the core of the program lies an unwavering commitment to academic and scientific excellence, providing a comprehensive education encompassing fundamental principles, cutting-edge theories, and hands-on laboratory experiences essential for success in biotechnology. Graduates emerge with the competence to explore, experiment, and innovate within this multidisciplinary field.Biotechnology thrives at the intersection of multiple scientific domains, including biology, chemistry, genetics, and engineering. The curriculum reflects this interdisciplinary essence, encouraging students to engage with diverse scientific perspectives, fostering a holistic understanding of biotechnology's transformative potential.The program emphasizes the ethical dimensions of biotechnology, with students engaging not only with opportunities but also with the ethical responsibilities inherent in manipulating living organisms and genetic material, aiming to instill a profound sense of ethical duty among graduates.B.Sc. Biotechnology students are catalysts for research and innovation throughout their academic journey. The program provides opportunities for hands-on laboratory work, internships, and collaborative projects, empowering students to contribute to pioneering advancements in the field.In an interconnected global landscape, graduates are prepared to address worldwide challenges. The program promotes a global outlook, nurturing an appreciation for biotechnology's diverse applications across cultures and geographies.Recognizing the ever-evolving nature of biotechnology, the program instills a passion for lifelong learning, equipping graduates to adapt and thrive in a rapidly changing scientific landscape.Collaboration is at the heart of biotechnological progress, with students encouraged to work together, share knowledge, and collaborate with peers, faculty, and industry professionals, fostering a vibrant and supportive academic community.The program is firmly committed to ensuring that the benefits of biotechnology education are accessible to all, championing inclusivity, diversity, and equitable opportunities, providing a welcoming environment where all individuals can excel.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme:	**B.Sc.** Biotechnology
Programme Code:	
Duration:	**3 Years (UG)**

Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non- familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences

PROGRAM OUTCOMES

PO1	Deepen knowledge in biotechnology and apply it for personal and societal betterment
PO2	Cultivate critical thinking, analytical skills, and problem-solving abilities
PO3	Foster research-related competencies, including problem definition, hypothesis testing, data analysis, and interpretation.
PO4	Address local, regional, and national societal and environmental challenges through innovative solutions
PO5	Instill self-reliance and lifelong learning for continuous personal and professional advancement.
PO6	Promote employability, entrepreneurship, and ethical communication skills among students

PROGRAM SPECIFIC OUTCOMES

PSO1	Develop a comprehensive understanding of biochemical, analytical, biostatistical and computational domains.
PSO2	Gain proficiency in comprehending the technical intricacies of cutting-edge technologies used to tackle biological and medical challenges faced by humanity.
PSO3	Acquire analytical skills and hands-on expertise to engage in research within multidisciplinary settings
PSO4	Learn to effectively utilize library search tools and online databases to access and retrieve scientific information related to biochemistry and associated techniques.

Eligibility for admission

CandidateforadmissiontothefirstyearofB.Sc.DegreeCourseinBiotechnologyshallberequired to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry or Microbiology andChemistry.

3. Highlights of the RevampedCurriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content whereverrequired.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with researchaptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of itskind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for thestudents.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrialproblems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the careerpath.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the jobmarket.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software forAnalytics.

4. Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulatingmathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make thememployable
		• Training on Computing / Computational skills enable the students gain knowledge andexposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field workinvolving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independentlivelihood • Generates self –employment • Create small scaleentrepreneurs • Training to girls leads to womenempowerment
		• Discipline centric skill will improve theTechnical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domainknowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinarynature • Students are exposed to Latest topics on Computer Science / IT, that require strongstatistical background

		• Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in therespective sectors
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gainprofessional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning isenhanced • Application of the concept to real situation is conceived resulting in tangibleoutcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiringresearchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSCgroup services, etc.
Extra Credits: For Advanced Learners / Honors degree		• To cater to the needs of peer learners / research aspirants
Skills acquired from theCourses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

	from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10: Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11: Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12: Multicultural competence:** Possess knowledge of the values and beliefsof multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diversegroups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to: **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory. **PSO2: Critical Thinking:** Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoningability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities. **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computationalmodels. **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and

	collaborate in research projects. **PSO6: Self-directed & Lifelong Learning:** Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UGdegree.

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate	
	between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

B.Sc., Biotechnology
Programme Structure

Sem	Part	Course Code	Courses	Name of the Course	T/P	Credits	Ins. Hrs	Int. Marks	Ext. Marks	Total
I	Part – I	2311T	T/OL	**தமிழ் இலக்கிய வரலாறு**-I /Other Languages-I	T	3	6	25	75	100
	Part - II	2312E		General English-I	T	3	6	25	75	100
	Part III	23BBT1C1	CC-1	Cell and Molecular Developmental Biology	T	5	5	25	75	100
		23BBT1P1	CC-2	Practical I - Cell and Molecular Developmental Biology	P	3	4	25	75	100
			Generic Elective (Allied)	Biochemistry/ Microbiology/ Botany/ Home Science	T	3	3	25	75	100
				Practical IA - Respective Allied Theory Course	P	2	2	25	75	100
	Part IV	23BBT1S1/ 23BBT1S2	SEC	Food and Nutrition (or) Herbal Medicine	T	2	2	25	75	100
		23BBT1FC	FC	Public Health and Hygiene	T	2	2	25	75	100
				Total		**23**	**30**	**230**	**570**	**800**
II	Part – I	2321T	T/OL	**தமிழ் இலக்கிய வரலாறு**-II/ Other Languages-II	T	3	6	25	75	100
	Part - II	2322E	E	General English – II	T	3	6	25	75	100
	Part III	23BBT2C1	CC-III	Genetics	T	4	5	25	75	100
		23BBT2P1	CC-IV	Practical II-Genetics	P	4	4	25	75	100
		--	Generic Elective (Allied)	Biochemistry/ Microbiology/ Botany/ Home Science	T	3	3	25	75	100
				Practical - Respective Allied Theory Course	P	2	2	25	75	100
	Part IV	23BBT2S1	SEC -II	Environment Management in Industries	T	2	2	25	75	100
		23BBT2S2	SEC-III	Organic Farming and Health Management	T	2	2	25	75	100
			NMC	Naan Mudhalvan Course						
				Total		**23**	**30**	**200**	**600**	**800**
III	Part – I	2331T	T/OL	**தமிழக வரலாறும் பண்பாடும்**/ - Other Languages-III	T	3	6	25	75	100
	Part - II	2332E	E	General English – III	T	3	6	25	75	100
	Part III	23BBT3C1	CC-III	Immunology and Immunotechnology	T	4	5	25	75	100
		23BBT3P1	CC-IV	Practical III - Immunology and Immunotechnology	P	4	4	25	75	100
		--	Generic Elective (Allied)	Biochemistry/ Microbiology/ Botany/ Home Science	T	3	3	25	75	100
				Practical - Respective Allied Theory Course	P	2	2	25	75	100
	Part IV	23BBT3S1	SEC -IV	Biotechnology for Society	T	2	2	25	75	100
		233AT/ 23BBT3S2	SEC-V	Adipadai Tamil/Computational Biology	T	2	2	25	75	100
				Total		**23**	**30**	**200**	**600**	**800**
IV	Part – I	2341T	T/OL	**தமிழும் அறிவியலும்**/Other Languages–IV	T	3	6	25	75	100
	Part - II	2342E	E	General English – IV	T	3	6	25	75	100
	Part III	23BBT4C1	CC-VII	Genetic Engineering and rDNA	T	4	4	25	75	100

				Technology						
		23BBT4P1	CC-VIII	Practical IV – Genetic Engineering and rDNA Technology	P	4	4	25	75	100
		--	Generic Elective (Allied)	Biochemistry/ Microbiology/ Botany/ Home Science	T	3	3	25	75	100
				Practical-Respective Allied Theory course	P	2	2	25	75	100
	Part IV	23BBT4S1/ 23BBT4S2	SEC-VI	Food and Bioprocess Technology/Food Chemistry	T	2	2	25	75	100
		234AT 23BBT4S3/ 23BBT4S4	SEC-VII	Adipadai Tamil/ Global Climate Change/ Cyrobiology	T	2	2	25	75	100
		23BES4	EVS	Environmental Studies	T	2	2	25	75	100
				Total		**25**	**30**	**225**	**675**	**900**
V		23BBT5C1	CC-IX	Plant Biotechnology	T	4	5	25	75	100
		23BBT5C2	CC-X	Animal Biotechnology	T	4	5	25	75	100
		23BBT5C3	CC-XI	Environmental and Industrial Biotechnology	T	4	5	25	75	100
	Part III	23BBT5E1/ 23BBT5E2	DSE-I	Nano Biotechnology / Enzymology	T	3	4	25	75	100
		23BBT5P1	CC-XII	Practical V – Plant Biotechnology and Animal Biotechnology and Environmental and Industrial Biotechnology	P	4	5	25	75	100
		23BBT5E3/ 23BBT5E4	DSE-II	Bioethics and Biosafety / Cancer Biology	T	3	4	25	75	100
		23BBT5I		Internship/Industrial Visit		2	-			
	Part IV	23BVE5		Value Education	T	2	2	25	75	100
				Total		**26**	**30**	**175**	**525**	**700**
VI		23BBT6C1	CC-XIII	Bioentrepreneurship	T	4	6	25	75	100
		23BBT6C2	CC-XIV	Pharmaceutical Biotechnology	T	4	6	25	75	100
		23BBT6E1/ 23BBT6E2	DSE-III	Marine Biotechnology / Food Technology	T	3	4	25	75	100
	Part III	23BBT6E3/ 23BBT6E4/ 23BBT6E5	DSE-IV	Medical Biotechnology / Forensic Biotechnology / Good Laboratory Practices	T	3	4	25	75	100
		23BBT6PR		Project		4	8	25	75	100
	Part IV	23BBT6S1		Essential Reasoning and Quantitative Aptitude	T	2	2	25	75	100
		--		Extension Activities		1	-			
						20	**30**	**175**	**525**	**600**
						141				**4600**

- TOL-Tamil/Other Languages,
- E – General English
- CC - Core course –Core competency, critical thinking, analytical reasoning, research skill & teamwork
- Generic Elective(Allied)
- SEC-Skill Enhancement Course
- FC-Foundation Course
- DSE-Discipline Specific Elective
- T- Theory,P-Practical

Chairperson details: Dr. A. **Veera Ravi**. Professor, Department of Biotechnology, **Alagappa University**, Karaikudi.Mobile No: 9487149249

FIRST YEAR - SEMESTER – I

Title of the Course	**CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY**						
Paper No.	**Core I**						
Category	**Core**	**Year**	I	**Credits**	5	**Course Code**	23BBT1C1
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	4	1	-			5	
Prerequisites	Higher secondary Biology						
Objectives of the course	**On successful completion of the course, students will be able to** • Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell • Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane. • Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication,TranscriptionandTranslation and post translational modificationsof proteins. • Predicttheresponseofcellstotheintraandextracellularenvironmentbystudyingabout the intracellular signaling pathways. • Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.						

	Contents
UNIT I	Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).
UNIT II	Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes - Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.
UNIT III	Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code-Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.
UNIT IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.
UNIT V	Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals-Organogenesis.

Text Books

1	T. Devasena (2012), Cell Biology, Oxford University Press.
2	Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.
3	Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.
4	Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.

5	JamesD.Watson(2001),TheDoubleHelix:ApersonalaccountoftheDiscoveryofthe Structure of DNA, Touchstone Publishers.
Reference Books	
1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.
2	James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications.
3	Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press.
4	Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
5	Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.
Web Resources	
1	http://www.cellbiol.com/education.php
2	https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/
3	https://dnalc.cshl.edu/websites/
4	https://www.cellsignal.com/contents/science/cst-pathways/science-pathways
5	https://nptel.ac.in/courses/102/106/102106025/11.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Comprehend the Cell Theory and its historical importance and be able to differentiate between prokaryotic and eukaryotic cells, while recognizing their structural diversity	PO1,PO5
CO2	Understand the primary functions of biomacromolecules within cells and relate these to the structure and functions of major cell organelles in maintaining cellular homeostasis	PO1
CO3	Grasp the Central Dogma of the cell, elucidate the structure of DNA and RNA, and analyze the processes of DNA replication, transcription, and translation in prokaryotic and eukaryotic cells	PO1,PO2
CO4	Describe the cell cycle stages, the significance of checkpoints, and the distinctions between mitosis and meiosis.	PO1,PO2
CO5	Explain the processes of gametogenesis, fertilization, and early embryonic development, linking these concepts to the formation of germ layers and organogenesis in animals	PO1,PO5,PO6

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

S-Strong(3) **M-Medium(2)** **L-Low(1)**

CO /PSO	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO'

Title of the Course	**Practical - I CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY**						
Paper No.	**Core II**						
Category	**Core**	**Year**	I	**Credits**	3	**Course Code**	23BBT1P1
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	-	4			4	
Prerequisites	Higher secondary Biology						
Objectives of the course	This course aims at providing knowledge on • Demonstrate the operation of Light Microscope • Identify blood cells and its components • Isolate and identify plant, and animal cells. • Summarizes the concept ofgametes • Develop skill to perform cell fractionations.						

	Contents
UNIT I	Components of a Compound / Light Microscope.
UNIT II	Blood smear preparation and Identification of Blood cells Buccal smear preparation and Identification of squamous epithelial cells.
UNIT III	Isolation and Identification of plant cells.
UNIT IV	Observation of sperm & Egg Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.
UNIT V	Cell fractionation and Identification of cell organelles (Demo)

Skills acquired from this course	Microscopy Skills, Cell Identification, Sample Preparation, Embryo Observation, Placenta Classification, Lab Techniques.
Recommended Text	**Reference Books:** 1. Sylvia S. Mader and Michael Windelspecht. Essentials of Biology. 5th Edition. Publisher: McGraw-Hill Education. Year: 2021. 2. Bernadette F. Rodak, George A. Fritsma, and Elaine Keohane. Clinical Hematology Atlas. 6th Edition. Publisher: Saunders. Year: 2019. 3. Gerald Karp. Cell and Molecular Biology. 8th Edition. Publisher: Wiley. Year: 2015. 4. Lincoln Taiz and Eduardo Zeiger. Plant Physiology. 6th Edition. Publisher: Sinauer Associates. Year: 2021.
Reference Books	1. Elaine N. Marieb and Katja Hoehn. Essentials of Human Anatomy & Physiology. 11th Edition. Publisher: Pearson. Year: 2018. 2. Scott F. Gilbert. Developmental Biology. 11th Edition. Publisher: Sinauer Associates. Year: 2020. 3. George C. Kent. Comparative Anatomy of the Vertebrates. 10th Edition. Publisher: McGraw-Hill Education. Year: 2018. 4. Thomas D. Pollard and William C. Earnshaw. Cell Biology. 3rd Edition. Publisher: Elsevier. Year: 2007.

Course Learning Outcomes (for Mapping with POs and PSOs)
On successful completion of the course the students should be able to

- Prepare and examine blood smears for the identification of different types of blood cells

- Perform buccal smears and accurately identify squamous epithelial cells.
- Isolate and identify plant cells from various tissues using appropriate techniques
- Observe and distinguish sperm and egg cells under a microscope, gaining insights into reproductive biology
- Successfully mount and observe chick embryos at different developmental stages, as well as identify various types of placenta in mammals. Gain hands-on experience in cell fractionation techniques and identify cell organelles through demonstration, enhancing understanding of cellular organization and functions in biological systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M

CO-PO Mapping (Course Articulation Matrix)

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course	**FOOD AND NUTRITION**						
Paper No.	**SEC –I**						
Category	**NME**	**Year**	I	**Credits**	2	**Course Code**	23BBT1S1
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	2	-	-			2	
Prerequisites	Higher Secondary Biology						
Objectives of the course	This course aims at giving an overall view of the • The student can determine the relationship between food , health and immunity • Able to explain the classification of foods and their deficiency • Can analyse the importance of BMR • Can outline the basic food groups and their adulteration Apply the concepts of food to prepare different food plans						

	Contents
UNIT I	Definition of food, Nutrition, Nutrient, Nutritional status, Dietetics, Balance diet, Malnutrition, Energy (Unit of energy-Joule, Kilocalorie). Health, Immunity by food and function of food.
UNIT II	Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine) -Sources, Classification, Function, Deficiencies of these nutrients. Function of water and dietary fiber.
UNIT III	BMR: Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals)
UNIT IV	Basic five food groups, nutritional significance of cereals, pulses, milk, meat, fish, vegetables, egg, nuts, oils and sugars. Food toxins, Food additives, Food quality, Safe food handling, Food adulteration, Preservatives and Packaging.
UNIT V	Principles and Objectives of meal planning. Diet for an infant, preschool child, School child, normal male and female of different occupations.
Text Books	
1	Vidya & D.B. Rao, 2010. A textbook of nutrition by, Discovery Publishing house,
2	Handbook of Nutrition & Food, third edition, CRC Press (Taylor and Francis group) by Carolyn D.Berdanier
3	Food science and Nutrition, Oxford publication by Sunetra Roday
4	Janet D Ward & Larry T Ward, Principles of food science by, Good heart-Wilcox publishing.
5	Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press.
Reference Books	
1	Joshi, V.K. and Singh, R.S., A. (2013), *Food Biotechnology- Principles and practices,* I.K.International Publishing House Pvt. Ltd., NewDelhi,.
2	RavishankarRai, V,(2015), *Advances in Food Biotechnology*, (First edition), John Wiley & Sons, Inc, ISBN9781118864555

3	Foster, G.N., (2020), *Food Biotechnology*, (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348
4	Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin (2005), *Food Biotechnology*, (2nd edition), *CRC Press,* ISBN 9780824753290
5	Perry Johnson-Green (2018), *Introduction to Food Biotechnology*, Special Indian Edition, *CRC Press*, ISBN 9781315275703

Course Learning Outcomes (for Mapping with POs and PSOs)
On completion of the course the students should be able to

CO1: Understand energy units and their relevance.
CO2:Identify and classify nutrients and Explain nutrient functions and deficiencies.
CO3: Describe water and fiber roles in diets, BMR, factors, and calculate energy needs.Analyze food groups' nutritional importance and Discuss food safety, quality, and additives.
CO4: Explain meal planning principles and Plan diets for different age groups and occupations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M

CO-PO Mapping (Course Articulation Matrix)

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Title of the Course	**HERBAL MEDICINE**						
Paper No.	**SEC-I**						
Category	**NME**	**Year**	I	**Credits**	2	**Course Code**	23BBT1S2
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	2	-	-			2	
Prerequisites	Higher Secondary Biology						
Objectives of the course	This course aims at providing an overall view of the • The student can analyses the importance of herbal medicine • can learn the role of herbal medicines for health • Can explain about Tribal medicine • can analyses the role of traditional medicine for today's health • can demonstrate the use of medicinal herbs to health						
	Contents						
UNIT I	Ethnomedicine – definition, history and its scope – Inter disciplinary approaches inethnobotany – Collection of ethnic information.						
UNIT II	Importance of medicinal plants – role in human health care – health and balanced diet(Role of proteins, carbohydrates, lipids and vitamins).						
UNIT III	Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion– *Aegle marmelos*, *Ficus benghalensis*, *Curcuma domestica*, *Cynodondactylon* and Sesamumindicum.						
UNIT IV	Traditional knowledge and utility of some medicinal plants in Tamil Nadu – *Solanum trilobatum*, *Cardiospermum halicacabum*, *Vitex negundo*, *Adathoda vasica*,*Azadirachta indica*, *Gloriosa superba*, *Eclipta alba*, *Aristolochia indica* and*Phyllanthus fraternus*.						
UNIT V	Plants in day today life – *Ocimum sanctum*, *Centella asiatica*, *Cassia auriculata*, *Aloevera*. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and Vegetables - Greens (Moringa, *Solanum nigrum* Cabbage).						

Text Books	
1	Deepak Acharya and Anshu Shrivastava. Ethnobotany: Principles and Applications. 1st Edition. Publisher: Science Publishers. Year: 2008.
2	Ivan A. Ross. Medicinal Plants of the World: Chemical Constituents, Traditional and Modern Medicinal Uses. 2nd Edition. Publisher: Humana Press. Year: 2020
3	Abayomi Sofowora. Medicinal Plants and Traditional Medicine in Africa. 3rd Edition. Publisher: Spectrum Books Ltd. Year: 2013.
4	Ruth A. Roth. Nutrition and Diet Therapy. 11th Edition. Publisher: Cengage Learning. Year: 2019.
5	Zohara Yaniv and Nativ Dudai. Handbook of Medicinal Plants. 1st Edition. Publisher: Taylor & Francis. Year: 2020.
Reference Books	
1	David E. Allen and Gabrielle Hatfield. Medicinal Plants in Folk Tradition: An Ethnobotany of Britain and Ireland. 1st Edition. Publisher: Timber Press. Year: 2004

2	A. Catharine Ross, Benjamin Caballero, Robert J. Cousins, and Katherine L. Tucker (Editors). Modern Nutrition in Health and Disease. 12th Edition. Publisher: Lippincott Williams & Wilkins. Year: 2020.
3	Andrew Chevallier. The Encyclopedia of Medicinal Plants. 1st Edition. Publisher: DK. Year: 1996.
4	Susan G. Dudek. Nutrition Essentials for Nursing Practice. 8th Edition. Publisher: Wolters Kluwer. Year: 2019.
5	Cecilia Garcia and James D. Adams Jr. Healing with Medicinal Plants of the West - Cultural and Scientific Basis for their Use. 1st Edition. Publisher: Abedus Press. Year: 2017.

Course Learning Outcomes (for Mapping with POs and PSOs)
On completion of the course the students should be able to

- Understand Ethnomedicine, Ethnobotany, and interdisciplinary approaches.
- Recognize the importance of medicinal plants in human health and balanced nutrition.
- Explore tribal medicine, disease diagnosis, and plants in folk religion.
- Learn about traditional medicinal plants in Tamil Nadu.
- Gain knowledge of plants in everyday life and their nutritive and medicinal value.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td>Title of the Course</td><td colspan="8">Foundation of Course for Biotechnology</td></tr>
<tr><td>Paper No.</td><td colspan="8">Foundation Course – PUBLIC HEALTH AND HYGIENE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2"></td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">23BBT1FC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours perweek</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="3">2</td></tr>
<tr><td>Prerequisites</td><td colspan="8"></td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• can explain the importance of health and hygiene
• can analyze the importance of food and malnutrition
• can understand the cause of diseases
• Will get know about lifestyle diseases
• Will get awareness about various Health Services Organizations</td></tr>
<tr><td>Unit-I</td><td colspan="8">Scope health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.</td></tr>
<tr><td>Unit-II</td><td colspan="8">Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres.Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).</td></tr>
<tr><td>Unit-III</td><td colspan="8">Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus,plague, whooping cough, diphtheria, leprosy. sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.</td></tr>
<tr><td>Unit-IV</td><td colspan="8">Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction.Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy) Obesity (Definition and consequences). Mental illness(depression and anxiety). Oral and lung cancer and their preventive measures.</td></tr>
<tr><td>Unit-V</td><td colspan="8">Health Services Organizations: World Health Organization (WHO), United Nations International Children’s Emergency Fund (UNICEF) and Indian Red Cross(IRC).</td></tr>
<tr><td colspan="9">Text Books</td></tr>
<tr><td>1</td><td colspan="8">Mary Jane Schneider (2011) Introduction to Public Health.</td></tr>
<tr><td>2</td><td colspan="8">Muthu, V.K. (2014) A Short Book of Public Health.</td></tr>
<tr><td>3</td><td colspan="8">Detels, R. (2017) Oxford Textbook of Public Health (6th edition).</td></tr>
<tr><td>4</td><td colspan="8">Gibney, M.J. (2013) Public Health Nutrition.</td></tr>
<tr><td>5</td><td colspan="8">Wong, K.V. (2017) Nutrition, Health and Disease.</td></tr>
<tr><td colspan="9">Reference Books</td></tr>
</table>

1	S. Lal, (2018), Vikas. *Public Health Management Principles And Practice*, 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.
2	Mary-Jane Schneider (2016), *Introduction to Public Health*,(5th Edition), Jones & Bartlett Learning,. ISBN-13: 978-1284197594
3	Carolyn D. Berdanier, JohannaT. Dwyer, DavidHeber (2013), *Handbook of Nutrition and Food*, (3rd Edition), CRC Press,. ISBN9781466505711
4	Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), *Principles of Occupational Health and Hygiene: An Introduction, (* 2nd Revised ed. Edition), Allen &Unwin,
5	V. Kumaresan, R. Sorna Raj*, (*2012) *Public Health and Hygiene*,(1st Edition), Saras Publication.

On completion of the course the students should be able to

1. Understanding health and hygiene: Gain a comprehensive understanding of health and hygiene, including the concepts of health and disease, and their impact on individuals and communities.
2. Environmental health awareness: Explore the link between pollution and health hazards, focusing on water and airborne diseases, as well as radiation hazards from mobile cell towers and electronic devices.
3. Promoting preventive measures: Learn about the role of health education in improving the environment and preventing diseases, emphasizing personal hygiene, oral hygiene, and sex hygiene.
4. Nutrition essentials: Classify food into micro and macro nutrients, discover the importance of a balanced diet and dietary fibers, and understand the significance of breastfeeding for healthy development.
5. Disease awareness and prevention: Gain insights into various communicable diseases, including both viral and bacterial infections, sexually transmitted diseases, and non-communicable diseases. Explore preventive measures and the roles of global health organizations like WHO, UNICEF, and IRC in healthcare services.

SEMESTER – II

Subject Code	CORE II	L	T	P	S	Credits	Hours	Marks		
								CIA	External	Total
23BBT2C1	**GENETICS**		T			4	5	25	75	100

Learning Objective	
LO1	Learn about the classical genetics and transmission of characters from one generation to the next.
LO2	Obtain a strong foundation for the advanced genetics.
LO3	Explain the properties of genetic materials and storage and processing of genetic information.
LO4	Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.
LO5	Categories Eugenics, Euphenics and Euthenics and indepth Knowledge on population Genetics.

	Contents	**No. of Hours**
UNIT I	Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.	15
UNIT II	Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over-types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex- Determination in Man.	15
UNIT III	Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction	15
UNIT IV	Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)	15
UNIT V	Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.	15
Total		75

Text Books

1	Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram
2	Nath Publications, Meerut, 250001. www.knrnpublications.com, ISBN-978-81-907011-2-9
3	Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S.Chand & Co., New Delhi – 10055.
4	Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S.Chand and Co., New Delhi, 110055.

Reference Books	
1	Gardener E.J. Simmons M.J. Slustad D. P. 2006. Principles of Genetics
2	Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill.
3	Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H.Freeman. New York.
4	Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd
5	Good enough U. 1985. Genetics. Hold Saunders international.
Web Resources	
1	https://nptel.ac.in/courses/102/106/102106025/
2	http://www.ocw.mit.edu
3	http://enjoy.m.wikipedia.org
4	https://www.acpsd.net

MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**
TOTAL	**15**	**14**	**14**	**15**	**13**	**14**	**14**	**13**	**13**
AVERAGE	**3**	**2.8**	**2.8**	**3**	**2.6**	**2.8**	**2,8**	**2.6**	**2.6**

Core Practical II - Genetics

Subject Code	CORE II	L	T	P	S	Credits	Hours	Marks		
								CIA	External	Total
23BBT2P1	**Practical –II GENETICS**			P		4	4	25	75	100

Learning Objective	
LO1	Demonstrate the basic principles of important techniques in Molecular biology and Genetics.
LO2	Analyze the Polytene chromosome of the organisms
LO3	Identify Barr bodies from Buccal smear
LO4	Demonstrate the Preparations and maintenance of culture medium
LO5	Demonstrate Human karyotyping

	Contents	**No. of Hours**
UNIT I	Mitotic stages of onion (*Allium cepa*) root tip Meiotic stages of cockroach testes/ Flower bud	9
UNIT II	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands	9
UNIT III	Identification of Barr bodies from Buccal smear	9
UNIT IV	Preparations of culture medium and culture of Drosophila – methods of maintenance Identifications of mutants of Drosophila	9
UNIT V	Human karyotyping (Demo)	9

Text Books

Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CLO5	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**14**	**14**	**14**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**3**	**2.8**	**2.8**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

ENVIRONMENT MANAGEMENT IN INDUSTRIES

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT2S1	**1**	**1**			**2**	**2**	**25**	**75**	**100**

Learning Objective	
LO1	The student understands the need of Instruments for Medical field
LO2	Can examine the setup of Diary Industry
LO3	learn the Management skills for Agri Industry
LO4	understanding of hazards in Workplace
LO5	Gains knowledge about Industrial hazards and its prevention

	Contents	**No. of Hours**
UNIT I	Introduction to life science, computer in life science-Medical imaging, Genomics and phylogenetics, Drug design and discovering, Assistive robotics, Brain-computer interfaces, Simulation of biological systems and Medical treatment optimization.	15
UNIT II	Introduction to Dairy industries, The Structure of Dairying in Developing Countries, Application of Computer in Dairy Industry, Milk Procurement & Billing, Plant Automation, Computerized Accounting System, Applications of Management Information System (MIS), Packaging, Supply Chain Integration and Traceability.	15
UNIT III	Agribusiness - Application of marketing and decision making in contemporary agribusiness firms. Marketing strategies, marketing research and information, segmentation and targeting, Professional selling skills and knowledge – Rural Development – NABARD.	15
UNIT IV	Hazards in the workplace: Pressure, Biological, Chemical, Electricity, Fire, Heat & Cold, Indoor Air Quality, Lighting, Noise, ergonomics, Radiation (ionizing & non ionizing), Vibrations, hours of work, violence in work place, Understanding of Material Safety Data Sheets, Accidents and Safety Management: Accident Prevention methods, Safety Management and audit, Personal Protection Approaches.	15
UNIT V	Occupational Health & Industrial Hygiene: Scientific and engineering basis for occupational health, biological monitoring (e.g. BEI), Occupational Hygiene, Concept of First Aid, Preventive Measures, and Occupational Health & Safety Management System: OHSAS – 18000.	15
Total		**75**

Text Books	
1	Multi-Criteria Decision Analysis for Risk Assessment and Management, Editors Jingzheng Ren, Series Title Industrial Ecology and Environmental Management PublisherSpringer Cham, DOIhttps://doi.org/10.1007/978-3-030-78152-1
2	Environmental Management,Butterworth-Heinemann,Editor(s): Iyyanki V. Muralikrishna, Valli

	Manickam,2017, Page iv,ISBN 9780128119891,https://doi.org/10.1016/B978-0-12-811989-1.12001-9.(https://www.sciencedirect.com/science/article/pii/B9780128119891120019)
3	Life Cycle Sustainability Assessment for Decision-Making Methodologies and Case Studies Book • 2020 Editors Jingzheng Ren & Sara Toniolo
Reference Books	
1	Lalat Chander, 2010. Text book of Dairy Plant Layout and Design, ICAR, New Delhi.
2	Larry R. Collins, 2001.Physical Hazards of the Workplace, CRC Press, Taylor&Francis group.
3	Andrew Barkley, 2013, Principles of Agricultural Economics, Taylor&Francis group.
4	Mishra R.K., 2015. Occupational health management, Aitbs Publishers and Distributors- Delhi.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**15**	**15**	**13**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**3**	**3**	**2.6**	**3**	**3**	**3**

ORGANIC FARMING AND HEALTH MANAGEMENT

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT2S2	**2**				**2**	**2**	**25**	**75**	**100**

Learning Objective	
LO1	the student will value the concepts of ecology and environment
LO2	To know the techniques of Vermicomposting and enjoying the cultivation of common Medicinal Herbs
LO3	To gain the knowledge about Principles and Policies in Organic forming and Certification agencies
LO4	To realize the Concept of Health and importance of well being
LO5	To appreciate the Role of exercise and nutrition in Health related fitness

	Contents	**No. of Hours**
UNIT I	Ecology and Environment – Principles of ecology – Ecosystem - Biotic and abiotic components and interaction – Energy flow –Nutrient cycle – Biodiversity – Endemic – Exotic - Interrelationships.	15
UNIT II	Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.	15
UNIT III	Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability.	15
UNIT IV	Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.	15
UNIT V	Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.	15
Total		**75**

Text Books	
1	G.K. Veeresh, 2006. Organic farming , First edition, New Delhi, India Foundation Books in association with Centre for Environment Education.
2	Mangala rai, 2012.Hand Book of Agriculture, Sixth Edition, ICAR New Delhi.
3	B.B. Sharma , 2007. A Guide to Home Gardening, Second Edition, MIB India, New Delhi.

4	Adrianne E. Hardman, 2009. Physical Activity and Health – The evidence explained, Second edition, Taylor and Francis Group.
5	
Reference Books	
1	Farmers of Forty Centuries: Permanent Organic Farming in China, Korea, and Japan Hardcover – 10 June 2011by F. H. King (Author)
2	Organic Farming: Components And Management Edition: 1 Author/s:Gehlot D , Publisher: M/s AGROBIOS (INDIA) ISBN: 9788177544008

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

SEMESTER – III

Core IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT3C1	**4**	**1**			**4**	**5**	**25**	**75**	**100**

Learning Objective		
LO1	Explain the role of immune cells and their mechanism in body defense mechanism.	
LO2	Demonstrate the antigen –antibody reactions in various immune techniques.	
LO3	Gain new insights into Antigen -Antibody interactions and to demonstrate immunological techniques.	
LO4	Gain knowledge of production of vaccines.	
LO5	Apply the knowledge of immune associated disease, hypersensitivity reactions.	
	Contents	No.of Hours
UNIT 1	Introduction to Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired.	15
UNIT II	Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.	15
UNIT III	Antigen – Antibody interactions, Immunodiffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Flourescent antibody technique and Western Blotting. Purification of antibodies.	15
UNIT IV	The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Biological function of C' proteins. Cytokines- Structure and Function. Vaccines – Types, Production and application.	15
UNIT V	Hypersensitivity Reactions and Types. Major Histocompatability Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing.	15
Total		**75**

Text Books

1	Thomas J. Kindt, Barbara A. Osborne and Richard A Goldsby, 2006. Kuby Immunology. 6th edition, W. H . Freeman and Company.
2	Kannan, I., 2010. Immunology. MJP Publishers, Chennai
3	Abbas, A.K., A.H.L., Lihtman and S. Pillai, 2010. Cellular and Molecular Immunology, 6th Edition. Saunders Elsevier Publications, Philadelphia

4	NandiniShetty, 1996, Immunology : introductory textbook – I. New Age International, New Delhi.
5	Fahim Halim K.,2009. The Elements of Immunology. Pearson Education.
Reference Books	
1	Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 12th edition, Wiley- Blackwell. USA.
2	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
3	William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4	Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.
5	Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition
Web Resources	
1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html
3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | Science Direct Topics

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	2	3	3	3	3
CLO4	3	3	3	2	3	2	3	3	2
CLO5	3	3	2	3	3	3	3	2	3
TOTAL	15	15	14	14	14	14	15	14	14
AVERAGE	3	3	2.8	2.8	2.8	2.8	3	2.8	2.8

Core Practical III - IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT3P1			**4**		**4**	**4**	**25**	**75**	**100**

Learning Objective	
LO1	Perform blood grouping and determine blood type.
LO2	Able to count WBC and RBC.
LO3	Conduct serological diagnostic tests such as ASO, CRP, RA and Widal test.
LO4	Acquire technical skills required for immunodiffusion and know the principle behind the techniques.
LO5	Able to Demonstrate ELISA, Handling of Laboratory animals.

	Contents	No. of Hours
UNIT 1	Separation of Serum and Plasma. Blood grouping and Rh typing.	9
UNIT II	WBC counting RBC counting Differential blood count	9
UNIT III	WIDAL Slide test ASO test	9
UNIT IV	Double Immunodiffusion Single Radial Immunodifusion	9
UNIT V	ELISA – Demonstration Handling of Laboratory animals - Demonstration Skin test – Demonstration	9
Total		**45**

Text Books	
1	Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2	Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.
Reference Books	
1	Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley-Blackwell.
2	Rose. (1992). Manual of Clinical Lab Immunology, ASM.

3	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell.
Web Resources	
1	https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
2	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
3	https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | ScienceDirect Topics

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**15**	**14**	**14**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**3**	**3**	**2.8**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

BIOTECHNOLOGY FOR SOCIETY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT3S1	**2**				**2**	**2**	**25**	**75**	**100**

Learning Objective	
LO1	Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation
LO2	Will gain knowledge about the production of Bio fertilizer and advantages of Biopestisides
LO3	Will understand the significance of microorganisms in Biodegradation
LO4	Will get know about History of Antibiotics
LO5	Will able to comprehend about Transgenic Plants

	Contents	**No. of Hours**
UNIT 1	Introduction to Biotechnology- Role of Biotechnology in sericulture- Rearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained- Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation.	15
UNIT II	Biofertilizer- Definition- Mass production of *Rhizobium*-Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- *Bacillus thuringiensis*- Single cell protein- Introduction- history- production of *Spirulina* SCP- Applications- Advantages & disadvantages.	15
UNIT III	Biodegradation- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages- Bio weapons- introduction- history- potential agents- delivery methods- harmful effects.	15
UNIT IV	Antibiotics- Definition- Introduction and history of antibiotics- sources- classification- spectrum- production of penicillin- definition of antibiotic resistance.	15
UNIT V	Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.	15
Total		**75**

Text Books	
1	Sathyanarayana, U., Chakrapani, U., (2008). *Biotechnology,* First edition, Books and allied (P) Ltd, Kolkata.
2	A.K. Chatterji, (2011).*Introduction to Environmental Biotechnology,* Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9
3	R.C. Dubey, (2014*). A text book of Biotechnology*, *S.Chand& Company, New Delhi.* ISBN 9788121926089

4	H. Patel, (2011).*Industrial Microbiology*,(2nd edition), MacMillan Publishers
5	Thakur, I.S., (2019).*Environmental Biotechnology- Basic principles and applications- (*2nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9
3	
1	Basics of Biotechnology Paperback – 1 January 2004 by A.J. Nair (Author) Publisher Laxmi Publications
2	Basic Biotechnology Paperback – 2 February 2008 by Ratledge Colin (Author) Publisher Cambridge University Press

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**
CLO3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**
TOTAL	**15**	**14**	**15**	**15**	**14**	**15**	**13**	**14**	**15**
Average	**3**	**2.8**	**3**	**3**	**2.8**	**3**	**2.6**	**2.8**	**5**

]

COMPUTATIONAL BIOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT3S2	**1**	**1**			**2**	**2**	**25**	**75**	**100**

Learning Objective	
LO1	Will understand Primary and Secondary Biological Databases which are currently used in Bioinformatics
LO2	Will able to identify the similarity between the Sequences by using different software's
LO3	Develop skills to generate Phylogenetic trees for the analysis of multiple sequences alignment and phylogenetic analysis (PHYLIP)
LO4	Will gain knowledge of Drug Discovery and Drug designing
LO5	Will expertise in Structure prediction of proteins and homology modeling of proteins by learning different types of Visualization tools and Gene prediction tools.

	Contents	**No. of Hours**
UNIT 1	Overview and Definition, Application of Bioinformatics, Sequences format used in Bioinformatics- Biological Database: Introduction, Classification of biological databases, Primary database- Nucleic acids- NCBI-DDBJ-EMBL. Protein- PDB- SWISSPORT. Secondary database- PROSITE, PFAM. Structure and classification-SCOP-CATH, Metabolic pathway database.	15
UNIT II	Sequences similarity, Identify & homology- Definition of homologues, Orthologues, Paralogues. Scoring matrices, Pairwise Sequences alignment. Dot Matrix, BLAST, FASTA- Needleman Wunsch – Smith and waterman Algorithm.	15
UNIT III	Multiple Sequences alignment – Different method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenic trees- rooted and unrooted tree- Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis (PHYLIP).	15
UNIT IV	History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.	15
UNIT V	Protein prediction - Study of internet resources in Bioinformatics -Tools for primary (Compute PT/Mw, Protparam), secondary (PROSITE), Tertiary (Swiss Model), Structure prediction of proteins, Homology modeling of proteins. Visualization tools (RASMOL), Gene prediction tools (Genscan, Grail).	15
Total		**75**

Text Books	
1	Rastogi, S.C, Mendiratta, N,Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.
2	David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK;

	2009.
3	D.R.Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.
4	Gautam B. Singh., Fundamentals of Bioinformatics and Computational Biology, Oakland University Rochester, Michigan USA.
5	Arthur M.Lesk., Introduction to bioinformatics., Oxford University Press.
Reference Books	
1	Mohammad AmjadManaullahAbid. (2019). *Fundamentals of Computers*. (1st Ed.)DreamtechPress, ISBN-978-93-89520-39-2
2	S.P. Gupta (2019), *Biostatistical methods* (1st Ed.)Sultan Chand and Sons, ISBN 93-5161-112-7
3	Veer Bala Rastogi (2018). *Biostatistics*. Medtech Publisher, ISBN: 9789384007591, 9384007595
4	Jerrold H. Zar (2014*), Biostatistical Analysis* (5th Ed), New Delhi: Pearson Education
5	Priti Sinha Pradeep K. Sinha (2018). *Computer Fundamentals* (6th Ed.) BPB Publications; Reprint Edition, ISBN: 9788176567527
Web Resources	
1	**www.expasy.org**

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**13**	**13**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**2.6**	**2,6**	**3**	**3**	**3**	**3**

SEMESTER –IV
Core Paper IV- Genetic Engineering and rDNA Technology

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4C1	**4**				**4**	**4**	**25**	**75**	**100**

Learning Objective	
LO1	Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.
LO2	Enumerate various recombinant techniques and gene probes and molecular markers identification.
LO3	Understand Gene transfer techniques by Viral and Nonviral mediated gene transfer mechanisms.
LO4	Exhibit knowledge in sequencing technologies and protein engineering techniques.
LO5	Explore the strategies of Recombinant DNA Technology in r medicine, Industry and agriculture.

	Contents	**No. of Hours**
UNIT 1	Genetic Engineering – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies (enzymes, vectors, host) – introduction of rDNA into host cells.	15
UNIT II	Identification of recombinants, selection and screening for Recombinants. DNA sequencing – Construction of Genomic DNA library and cDNA library), Chromosome walking. Human Genome Project. Polymerase Chain reaction-Methodology and its Types.	15
UNIT III	Gene transfer techniques – Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer - Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes.	15
UNIT IV	Gene Expression – Expression system and their applications - protein based products – Protein engineering– production of protein from cloned genes. Site directed Mutagenesis, Restriction Fragment Length Polymorphism (RFLP).	15
UNIT V	Application of Recombinant DNA technology in medicine, industry, agriculture and r-DNA technology - merits and demerits.	15
Total		**75**

Text Books

1	Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.
2	Desmond S.T. Nicholl, 2008. An Introduction to Genetic Engineering, 3rd edition, Cambridge university press.
3	R.W. Old & S.B. Primrose, Principles of Gene Manipulation, Fifth Edition, Blackwell Science.
4	Genetic Engineering Principles and Methods by Setlow, Jane K. (Volume 24).
5	Keya Chaudhuri, 2012. Recombinant DNA Technology.
Reference Books	
1	David Clark Nanette Pazdernik Michelle McGehee (2018), *Molecular Biology techniques*,(3rd edition).
2	Anton Byron (2019), *Introduction to Gene Cloning,* Publisher: Oxford Book Company
3	Monika Jain (2012), *Recombinant DNA technology*, (I edition), Alpha Science International. ISBN-13 : 978-1842656679.
4	Primrose.S.B (2014), *Principles of gene manipulation*, (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3
Web Resource	
1	https://www.britannica.com/recombinant-DNA-technology
2	https://www.le.ac.uk/recombinant-dna-and-genetic-techniques
3	https://www..ncbi.nlm.nih.gov

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**15**	**14**	**14**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**3**	**3**	**2.8**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

Core Practical IV- GENETIC ENGINEERING AND rDNA TECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4P1			4		4	4	25	75	100

Learning Objective		
LO1	Isolate the Plasmid DNA and Genomic DNA. and predict the molecular weight of DNA by agarose gel electrophoresis.	
LO2	Demonstrate working principles of PCR, RFLP and other important Genetic Engineering techniques.	
LO3	Prepare the competent cells and perform bacterial transformation.	
LO4	Determine the restriction digestion of DNA	
LO5	Determine the restriction fragment length polymorphism.	
	Contents	**No. of Hours**
UNIT 1	Isolation of genomic DNA Isolation of plasmid DNA	9
UNIT II	Isolation of RNA	9
UNIT III	Production of competent cells for transformation Bacterial transformation	9
UNIT IV	Restriction Digestion of DNA	9
UNIT V	Restriction Fragment Length Polymorphism(DEMO) PCR(Demonstration)	9
Total		45

Text Books	
1	Laboratory Manual for GENETIC ENGINEERING 1st Edition, Kindle Edition by S. JOHN VENNISON (Author) 2009.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**15**	**14**	**14**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**3**	**3**	**2.8**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

SEC- FOOD AND BIOPROCESS TECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4S1	**2**				**2**	**2**	**25**	**75**	**100**

UNIT I	Introduction to Bioprocess Technology: History and Scope- Bioreactor: Design, parts and accessories, functions- Modes of Operation of fermenter – Batch & continuous - Types of reactors - Bubble column, Fluidized bed reactor, plug flow reactor.
UNIT II	Fermentation media design, sterilization and media requirement for industrial fermentation, Main parameters to be monitored and controlled in fermentation processes, aerobic and anaerobic fermentation processes. Development and scale up of bioreactors for production of biological products. Immobilization – Types of immobilization, various methods - Applications of immobilized enzyme technology.
UNIT III	Downstream processing: Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods. Enrichment operations: Membrane – based separations. Product finishing: precipitation/crystallization, mixing, dialysis, distillation and drying.
UNIT IV	Production of microbial enzymes (Amylase, Protease and Pectinase) applications, production of organic solvents (Ethanol, Methanol) – production of organic acids (Citric acid, Acetic acid) - Single cell protein production – Spirulina, Yeast, Actinomycetes protein. Beverages production – Beer and Wine.
UNIT V	Processing of Milk – Pasteurization and homogenization - Modifying milk composition – Production of milk products – Curd, cheese, yogurt, and flavoured milk. Bakery products – Bread making. Probiotics and Role of Food technology in bio-defense programs.

Course Outcome

Students will be able to assess nutritional status and apply the knowledge in understanding the metabolism and nutrient functions.

References:

1. Shuler, M.L. and Kargi, F. 2008. Bioprocess engineering – Basic concepts. Pearson Education.
2. M.L. Srivastava., 2010. Fermentation Technology, Narosa Publications.
3. Pauline M. Doran., 2009.Bioprocess Engineering Principles. Academic Press Inc.,
4. El-Mansi& Bryce C.F.A., 2007. Fermentation Microbiology and Biotechnology., 2nd edition, Taylor and Francis Publishing.

SEC- FOOD CHEMISTRY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4S2	**2**				**2**	**2**	**25**	**75**	**100**

UNIT I	Sources of food, types, advantages and disadvantages. Food adulteration - contamination of Wheat, Rice, Milk, Butter etc. with clay stones, water and toxic chemicals - Common adulterants. Common adulterants Ghee adulterants and their detection. Detection of adultered Foods by simple analytical techniques.
UNIT II	Food Poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion)- Chemical poisons - First aid for Poison consumed victims.
UNIT III	Food additives - artificial sweeteners- Saccharin - Cyclamate and aspartame. Food flavours - esters, aldehydes and heterocyclic compound. Food colours - Emulsifying agents-preservatives - leavening agents. Baking powder - yeast - taste makers - MSG vinegar.
UNIT IV	Beverages - soft drinks - soda - fruit juices - alcoholic beverages. Carbonation - addiction to alcohol - diseases of liver and social problems.
UNIT V	Fats, Oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases - determination of iodine value, RM value, saponification values and their significance.

References:

1. Swaminathan M., Food Science and Experimental foods, Ganesh and Company.
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers.
3. Thangamma Jacob, Text Books of applied chemistry for Home Science and Allied Sciences, Macmillan.

Course outcome:

On completion of the course the learner will know about adulterants, usage of pesticides and their effect.

SEC-GLOBAL CLIMATE CHANGE

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4S3	**2**				**2**	**2**	**25**	**75**	**100**
UNIT I	Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon foot print and ecological foot print.								
UNIT II	Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts for mitigation ozone layer depletion.								
UNIT III	Climate change: Greenhouse effects; causes; Greenhouse gases and their sources; Consequences on climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.								
UNIT IV	Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.								
UNIT V	Acid rain and its effects on plants, animals, microbes and ecosystems.								

References:

1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.
2. Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.
3. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.
4. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.

Course outcome:

On completion of this course, the students will be able to understand the concept and issues of global environmental change. They will gain knowledge about the physical basis of natural green gashouse effect on man and materials.

SEC- CRYOBIOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT4S4	**2**				**2**	**2**	**25**	**75**	**100**
UNIT I	Introduction to Cryobiology, cryopreservation - natural cryopreservation , temperature, risks, slow, permeable freezing, vitrification, uses freezable tissues, equipment, limitations.								
UNIT II	Liquid nitrogen – uses, safety, production; glass transition- introduction, transition temperature Tg, kauzmann's paradox, the glass transition, specific materials, silica, polymers, mechanism of vitrification, electronic structures; ex-situ conservation; cryoprotectants; cryostasis; neuropreservation.								
UNIT III	Cryopreservation in nature – antifreeze protein, antifreeze, psychrophile, insect winter ecology, cryogenic treatment, cryogenic seal, cryogenic fuel, energy storage, crystal, cryotank, absolute zero, target temperature management.								
UNIT IV	Hibernation , heterothermy, hibernaculum, hypothermia, chilblains, frost bite, trench feet, thermoregulation.								
UNIT V	Application of Cryobiology - cloning, molecular cloning, organ transplantation, sperm bank, semen extender, in-vitro fertilization, embryo transfer, cryosurgery, cryoablation.								

REFERENCE

1. Colby Gunn, A comprehensive introduction to Cryobiology,2017 library press publishing, New York.
2. http://ndl.iitkgp.ac.in/document/

Course Outcomes:

The course will help the student gain the knowledge about the latest cold preservation techniques. To learn and understand the detailed concept of cryopreservation, Nature's adaptation to cold conditions and the application of Cryobiology.

SEMESTER –V

PLANT BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5C1	5				4	5	25	75	100

Learning Objective	
LO1	Explore the history of Biotechnology and state the importance of organization of plant genome
LO2	Be acquainted with the molecular basis of action of plant hormones and gene expression
LO3	Illustrate about various culture medium preparations, haploid, triploid plant production and its applications
LO4	Exploit symbiotic organisms as a vector for gene transfer to produce transgenic plants
LO5	Develop molecular technique skills for crop improvement.

	Contents	No.of Hours
UNIT 1	History of plant biotechnology, Conservation of Plant using Biotechnology. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.	15
UNIT II	Auxins, cytokinins and gibberlins – molecular basis of action – phytochrome – role in photomorphogeneisis – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.	15
UNIT III	Media composition (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation, fusion and culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production.	15
UNIT IV	Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Tiand Ri Plasmid vectors and their utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.	15
UNIT V	Crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Transgenic plants- plant vaccines, genetically modified food - future perspectives & ecological impact of transgenic plants.	15

Total	**75**

Text Books	
1	Sudhir, M. 2000. Applied Biotechnology and plant Genetics. Dominant publishers and distributors.
2	Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.
3	Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
4	Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.
5	Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.
Reference Books	
1	Kojima, Lee, H. and Kun, Y. 2001. Photosynthetic microorganisms in Environmental Biotechnology. Springer – Verlag.
2	Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008.
3	Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
4	Trigiano, R.N. and Gray, D.J. 1996. Plant tissue culture concepts and laboratory exercise. CRC Press. BocaRatin, New York.
5	Street, H.E. 1977. Plant tissue culture. Blackwell Scientific Publications, oxford, London.
Web Resources	
1	https://nptel.ac.in/courses/102103016
2	https://science.umd.edu/classroom/bsci124/lec41.html
3	https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology
4	http://mydunotes.blogspot.com/p/plant-biotechnology.html
5	https://nptel.ac.in/courses/102103016

MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	2	3	1	1	2	3	3	3
CLO2	3	3	3	2	1	3	3	3	3
CLO3	3	3	3	3	2	2	3	3	3
CLO4	3	2	2	1	3	2	3	3	2
CLO5	3	3	3	2	3	3	3	2	3
TOTAL	**15**	**13**	**14**	**9**	**10**	**12**	**15**	**14**	**14**
AVERAGE	**3**	**2.6**	**2.8**	**1.8**	**2**	**2.4**	**3**	**2.8**	**2.8**

Core Paper VI - ANIMAL BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5C2	**5**				**4**	**5**	**25**	**75**	**100**

Learning Objective		
LO1	Understand the basic concepts of Animal cell culture and cell laboratory	
LO2	Describe the media preparation, preservation, trypsinization, counting, maintenance and application of cell lines.	
LO3	Discuss the strategies for gene transfer and gene expressions with their applications.	
LO4	Be acquainted with genetic modification and stem cell technology in production of transgenic animals.	
LO5	Learn the Assisted reproductive technology and its applications.	
	Contents	**No.of Hours**
UNIT 1	Animal cell culture – History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell line. Essential equipments required for animal cell culture.	15
UNIT II	Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.	15
UNIT III	Transfection of cells in culture- Animal viral vectors for transfection, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications.	15
UNIT IV	Protein production by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products - Transgenic Animals.	15
UNIT V	Collection and preservation of embryos, Semen banking, AI, IVF and ICSI. Case Study-any two relevant studies.	15
Total		**75**
Text Books		

1	Ramasamy.P. 2002.Trends in Biotechnology, University of Madras of Publications, Pearl Press
2	Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.
3	K. Srivastava *et al.,* 2009, Animal Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd.
4	B.C. Currell *et al.,* 1994, In vitro Cultivation of Animal Cells (Biotol), Butterworth-Heinemann Ltd.
5	Jenkins, N. (ed). 1999 Animal cell Biotechnology: Methods and protocols. Humana press, New Jesey.
Reference Books	
1	R. Ian Freshney, Culture of Animal cells – A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications.
2	Glick, B.R. and Pasternark. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA.
3	Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington.
4	Traven. 2001. Biotechnology. Tata McGraw – Hill.
5	Walker,J.M. and Gingold, E.B. 1999.Molecular biology and Biotechnology, 3rd edition. Panima Publishing Corporation.
Web Resources	
1	http://ecoursesonline.iasri.res.in/course/view.php?id=350
2	https://microbenotes.com/animal-cell-culture/
3	https://biocyclopedia.com/index/biotechnology/animal_biotechnology/manipulation_of_reproduction_and_transgenic_animals/biotech_in_vitro_fertilization_technology.php
4	https://thebiologynotes.com/embryo-transfer/
5	https://people.ucalgary.ca/~browder/transgenic.html

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	2	3	3	3	2	3	3	3
CLO2	3	3	3	2	1	3	3	3	3
CLO3	3	3	3	1	2	2	3	3	3
CLO4	3	2	2	2	3	2	3	3	3
CLO5	3	3	3	2	3	3	3	3	3
TOTAL	15	13	14	10	12	12	15	15	15
AVERAGE	3	2.6	2.8	2	2.4	2.4	3	3	3

Core Paper VI - ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5C3	5				4	5	25	75	100

Learning Objective		
LO1	Know about the environment, its issues and management of the environment.	
LO2	Explain the process of waste water treatment, drinking water treatment and solid waste management in various industries.	
LO3	Illustrate the significance of bioreactors in bioprocess engineering and culture methods.	
LO4	Explain Downstream processing, Fermented Products production and advanced methods	
LO5	Speculate the role and importance of microorganisms behind the ore leaching, production of food products and Biofertilizers.	
	Contents	**No. of Hours**
UNIT 1	Environmental Pollution – Sources and types - Water, Air, Thermal, Industrial and Radiation - Global environmental changes. Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.	15
UNIT II	Waste water treatment: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management. Bioenergy and SCP from waste. Drinking water treatment. Biotechnological approach to industrial effluent (Paper, Tannery, Textile) Pesticide waste disposal.	15
UNIT III	Bioprocess Engineering-Steps in bioprocess development. Design of bioreactors - Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenters. Fermentation systems Batch culture, Continuous culture, Fed-batch culture,	15
UNIT IV	Downstream processing Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing. Different types of fermented foods produced from microorganisms- Idli, Sauerkraut - Dairy products- Cheese and Yoghurt. Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips -Types and applications. Microbial	15

	Polysaccharide production: Xanthan, Dextran.	
UNIT V	Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - streptomycin. Alcoholic beverages: Wine, Beer –Biofertilizers- Rhizobium & Azotobacter. Biopesticides – *Bacillus thuringiensis* and microbial toxin production and their applications - Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids.	15
Total		75

Text Books	
1	Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi.
2	Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International, New Delhi.
3	Murugesan, A G., Rajakumari, C., 2005. Environmental Science and Biotechnology Theory and Techniques., MJP publishers, Chennai.
4	T.Satyanarayana, Bhavdish Narain Johri,Anil Prakash (2012), Microorganisms in Sustainable Agriculture and Biotechnology.
5	Madigan, Michael and Martinko, John, Brock biology of microorganism, 11th edition, (2005).
Reference Books	
1	Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,
2	Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, Elsevier Science Ltd
3	Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton (2001.), Industrial Microbiology: An Introduction. . Blackwell Science Ltd
4	Nduka Okafor, Modern Industrial Biotechnology & Microbiology (**(2017**, Science Publishers, Edenbridge Ltd.
5	Waites, Morgan, Rockey and Higton, Industrial Microbiology: An Introduction, Blackwell Science (2001).
Web Resources	
1	https://nptel.ac.in/courses/120/108/120108004/
2	https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf
3	www. Prenhall.com/Madigan
4	www.e-bug.eu/

5	www.microbeworld.org/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
CLO4	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**13**	**14**	**11**	**13**	**12**	**15**	**15**	**15**
AVERAGE	**3**	**2.6**	**2.8**	**2.2**	**2.6**	**2.4**	**3**	**3**	**3**

DSE-IA- NANO BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5E1	**3**				**3**	**4**	**25**	**75**	**100**

Learning Objective	
LO1	The students will get an outline about Nano biotechnology and its research in India.
LO2	To know about nanoparticles and their analysis using Advanced Instrumentation.
LO3	To get an insight about Nano devices
LO4	The students will know about the Applications of Nano biotechnology
LO5	The students will know about the Nano Biosensors and their applications.

	Contents	**No. of Hours**
UNIT 1	Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.	15
UNIT II	Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTRI. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM	15
UNIT III	Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.	15
UNIT IV	Agriculture: Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.	15
UNIT V	Nano biosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car).	15
Total		**75**

Text Books	
1	Vasantha Pattabhi and N. Gautham (2009), Biophysics, Narosa Publishmg House, New Delhi.

2	Narayanan.P (2010), Essentials of Biophysics, New Age International (P) Ltd. Publishers, New Delhi.
3	Rai, Mahendra, and Clemens Posten (2013). *Green biosynthesis of nanoparticles: Mechanisms and applications,* CABI, ISBN: 9781780642246.
4	Shanmugam.S, "Nanotechnology", MJP publishers, 2010.
5	Pradeep T (2012). *Textbook of Nanoscience and Nanotechnology*, McGraw Hill publications, ISBN: 9781259007323.
Reference Books	
1	D.Voet & J.G.Voet (2010), Biochemistry, John Wiley &Sons, New York.
2	Biochemistry by Lubert Stryer, 4th Ed., WH.Freeman, 1995.
3	David S. Goodsell, "Bionanotechnology", John Wiley &Sons Inc., publications, 2004.
4	Guozhong Cao (2004). Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial College Press, ISBN: 978-1860944802.
5	C.M.Niemeyer, C.A. Mirkin (2007). *Nanobiotechnology*, WILEY-VCH Verlag GmbH & Co. KG, Weinheim, ISBN: 9783527306589.
Web Resources	
1	http://vvm.org.in/study_material/ENG%20-20Indian%20Contributions% 20to% 20 Science.
2	https://www.jabonline.in/admin/php/uploads/16_pdf.pdf
3	https://www.youtube.com/watch?v=gSpHINVmgoE
4	https://www.youtube.com/watch?v=ITtGJUGXFKc
5	https://www.youtube.com/watch?v=4cGROrskvLM

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	2	2	2	2	2	3	3	3
CLO2	3	3	3	2	3	3	3	3	3
CLO3	3	3	3	3	2	3	3	3	3
CLO4	3	2	2	-	-	2	3	2	3
CLO5	3	3	3	2	3	3	3	3	3
TOTAL	15	13	13	9	10	13	15	15	15
AVERAGE	3	2.6	2.6	1.8	2	2.6	3	3	3

DSE- I B – ENZYMOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5E2	4				3	4	25	75	100

Learning Objective	
LO1	The students will learn the Fundamentals of Enzymology.
LO2	The students will study about the characteristic features of Enzymes.
LO3	The student will know about the details of Enzyme Kinetics.
LO4	The student will apply the biochemical techniques for enzyme isolation
LO5	The Student will understand the process of Immobilization of enzymes , Enzyme engineering and Designer enzymes in various Industrial purposes.

	Contents	No. of Hours
UNIT 1	Nomenclature and classification of enzymes according to the International Union of Biochemistry and Molecular Biologists Convention. Properties of enzymes and factors that influence rate of enzyme action (pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors). Definitions - Apoenzyme, holoenzyme, zymogens. Coenzymes – (Vitamin and Non vitamin origin). Transition state theory, standard free energy, activation energy.	15
UNIT II	Active site (definition, characteristic features), Enzyme specificity. Bisubstrate and multisubstrate reactions. ES complex formation, lock and key model and induced fit model. Enzyme units - IU & Katal. Turnover number. Isoenzymes (LDH & CPK), Definition – Ribozymes & Abzymes.	15
UNIT III	Enzyme Kinetics – Michaelis-Menten equation and its derivation, significance of Km and Vmax, Lineweaver- Burk plot and Eadie- Hofstee plot, Hanes-Woolf plot. Enzyme inhibition - competitive, Non- competitive, Uncompetitive – (Derivations not included). Allosteric inhibition - sequential model, concerted model, feedback inhibition.	15
UNIT IV	Membrane bound proteins – Fluid mosaic model. Extraction of enzymes – Chemical agents and Physical methods of extraction, French pressure cell and ultrasonication. Nature of the extraction medium. Technique for enzyme isolation, separation of cellular organelles by differential centrifugation, purification of enzymes- dialysis, chromatography, electrophoresis. Intracellular localization of enzymes and marker enzymes.	15

UNIT V	Immobilization of enzymes- Chemical and Physical methods. Clinical and industrial applications of immobilized enzymes. Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes.	15
Total		75

Text Books	
1	Satyanarayana. U. 2013. Biochemistry.4th edition, Elsevier India.
2	Jain J L, 2014, Fundamentals of Biochemistry, 7th edition, S.Chand publishing.
3	Rodwell, V.W, Bender D.A, Botham K.M. 2015, Harper's Illustrated Biochemistry, 30th edition. McGraw-Hill Education.
4	Fundamentals of Enzymology - Nicholas C. Price and Lewis Stevens., Oxford University Press, New Delhi.
5	Voet, D. and Voet, J.G. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,
Reference Books	
1	Enzyme – Palmer, 18th edition, 2004.London: Portland Press
2	Biochemistry- Jeremy M Berg, John L Tymoczko, and LubertStryer,6th Edition, Freeman Publications, 2006.
3	Ralph A. Messing (2012) Immobilised Enzymes Academic Press, NY.
4	Nelson D.L., and Cox, M.M. 2013. Lehninger Principles of Biochemistry. 6thedition.W.H. Freeman & Company.
5	Jeremy M Berg, Stryer, L. 2015. Biochemistry, 8th edition. Macmillan Learning.
Web Resources	
1	https://www.youtube.com/watch?v=AD3-v1oKjSk
2	https://www.youtube.com/watch?v=tPCOEUo6J8s
3	https://www.youtube.com/watch?v=ALwziZSRiqM
4	https://www.youtube.com/watch?v=0ZiCqwtFMTs

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**3**
CLO4	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**14**	**14**	**10**	**10**	**13**	**15**	**15**	**15**

AVERAGE	**3**	**2.8**	**2.8**	**2**	**2**	**2.6**	**3**	**3**	**3**

CORE PRACTICAL V- PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Instructional Hours**	**Marks**		
							CIA	**External**	**Total**
23BBT5P1	**-**	**-**	**5**		**4**	**5**	**25**	**75**	**100**

Learning Objectives		
LO1	Explain plant tissue culture and Illustrate Callus development.	
LO2	Develop technical skills in Protoplast isolation and Nucleus localization.	
LO3	Make use of the techniques used in preparing tissue culture medium and membrane filtration in culturing animal cells and prepare single cell suspension and evaluate cell counting and viability.	
LO4	Develop technical skills in isolation of DNA and RNA from plants and microorganisms.	
LO5	Examine the importance of trypsinization in monolayer and subculture and cryopreservation.	
	Contents	**No. of Hours**
UNIT 1	Plant tissue culture media preparation & sterilization techniques. Callus induction	**9**
UNIT II	Isolation of plant protoplast & viability test. Localization of nucleus using nuclear stain.	**9**
UNIT III	Preparation of Animal Tissue culture medium and membrane filtration Preparation of Single Cell Suspension & Cell counting Cell viability Test	**9**
UNIT IV	Isolation of plant DNA and plant RNA(Demo) Isolation of Agrobacterium plasmid DNA (Demo)	**9**
UNIT V	Trypsinization of monolayer and subculturing (Demo) Measurement of phagocytic activity (Demo) MTT Assay (Demo) Cryopreservation and thawing (Demo)	**9**
Total		**45**
Text Books		

1	Madhavi Adhav, 2009, Practical Biotechnology and Plant Tissue Culture, S.Chand & Company Ltd.
2	C. C. Giri, Archana Giri, 2007, Plant Biotechnology: Practical Manual, I.K. International Pvt Ltd.
3	Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009, Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application, Springer.
4	Debajit Borah (2018), *Environmental Biotechnology Theory and Lab Practices*, (2nd edition), Hardcover – Global Vision Publishing House, ISBN: 9788182205840
Reference Books	
1	S. Lal, Vikas. (2018), *Public Health Management Principles And Practice*, (2nd Edition), CBS Publishers and Distributors Pvt Ltd,ISBN 13: 9789387742932
2	S. Harisha. (2012), *Biotechnology procedures and experiments handbook*,ISBN13 9781934015117
Web Resources	
1	https://www.plantcelltechnology.com/pct-blog/different-types-of-tissue-culture-processes/
2	https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**2**	**-**	**2**	**3**	**3**	**3**
CLO2	**3**	**2**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CLO3	**3**	**3**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CLO4	**3**	**2**	**3**	**2**	**-**	**2**	**3**	**3**	**3**
CLO5	**3**	**3**	**2**	**1**		**2**	**3**	**3**	**3**
TOTAL	**15**	**13**	**12**	**9**	**-**	**10**	**15**	**15**	**15**
AVERAGE	**3**	**2.6**	**2.5**	**1.9**	**-**	**2**	**3**	**3**	**3**

CORE PRACTICAL VI - ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY

Learning Objective		
LO1	Students can able to isolate the microorganisms and determine their growth curve, generation time.	
LO2	To analyze the water samples, perform immobilization and production of Wine, Biogas and compost.	
LO3	Develop skills in bio fertilizer production and microbial identification.	
LO4	Gain basic skills to analyze raw milk and determine the pasteurization efficacy.	
LO5	Develop skills to perform efficiency tests of biofertilizers and biopesticides, microbial polysaccharide production.	
	Contents	**No.of Hours**
UNIT 1	Isolation of Air borne Pathogens Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.	9
UNIT II	Water analysis – MPN and BOD. Immobilization of whole yeast cells/ enzyme by Alginate beads. Production of wine Production of Biogas – *In vitro* & Compost Making.	9
UNIT III	Biofertilizer production/Spirulina production - field visit. (Report should be included in the record) Isolation and identification of starter organisms from Idli batter/ curd	9
UNIT IV	Grading of raw milk (Dye reduction test). Determination of efficiency of Pasteurization by quantitative phosphatase test.	9
UNIT V	Preparation and Efficiency testing of Biofertilizer/ Biopesticide. (Demo) Production of microbial Polysaccharide. (Demo)	9
Total		45
Text Books		
1	Aneja K R, *Laboratory Manual of Microbiology and Biotechnology*, MEDTECH, 2014.ISBN-13 : 978-9381714553	
2	Vijaya Ramesh, (2007), *Food Microbiology*, MJP Publishers, Chennai, ISBN-13 : 978-8180940194	
Reference Books		

1	Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed., (1983), *A Manual of Laboratory Techniques*, National Institute of Nutrition, ICMR, Hyderabad.
Web Resources	
1	**https://www.youtube.com/watch?v=3UafRz3QeO8**
2	**https://www.youtube.com/watch?v=jpuNYpvBmDM**
3	**https://www.youtube.com/watch?v=tUCfkNKyQyc**

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CLO2	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CLO3	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CLO4	**3**	**2**	**3**	**1**	**2**	**2**	**3**	**3**	**3**
CLO5	**3**	**2**	**3**	**1**	**2**	**2**	**3**	**3**	**3**
TOTAL	**15**	**10**	**15**	**8**	**10**	**10**	**15**	**15**	**15**
Average	**3**	**2**	**3**	**1,6**	**2**	**2**	**3**	**3**	**3**

DSE-II A- BIOETHICS & BIOSAFETY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5E3	4				3	4	25	75	100

Learning Objective		
LO1	The students will understand the concepts of Bioethics and Biosafety.	
LO2	The students will realize the impact of Gene cloning in societal problems and also understand the need of the Bioethics.	
LO3	The students will know about the importance of Ethical Clearance.	
LO4	The students will get knowledge about Patents Rights in the field of Research.	
LO5	The students will know about Biosafety and GLP.	
	Contents	**No. of Hours**
UNIT 1	Human Rights: Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.	**15**
UNIT II	Impact of gene cloning & Bioethics-Issues concerning reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion).	**15**
UNIT III	Bioethics of IPR - ethical criteria in biotechnology- animal ethics; Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects.	**15**
UNIT IV	Patents - Introduction -Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability – Non Patentable Inventions - Patent Application Procedure in India. Other Forms of IP: Copyright - Trade Mark – Industrial designs – Farmer's Rights. Patenting of Biotechnology products and processes.	**15**
UNIT V	Biosafety - General guidelines - DBT guidelines on biosafety in conducting research in biology / biotechnology - Risk assessment studies- Hazardous materials used in Biotechnology- Handling and Disposal - Good manufacturing practices & Good Laboratory practices, Containment facilities and Biosafety practices - Regulation on field experiments and release of GMO's - Labelling of GM foods - Guidelines for research in transgenic plants and Animals.	**15**

Total	**75**

Text Books	
1	Ignacimuthu, S (2009), *Bioethics*, Narosa Publication house, ISBN: 978-81-7319-966-0
2	V. Sree Krishna . V (2007), *Bioethics and Biosafety in Biotechnology*, (1st ed.), New Age International Private Limited.
3	Rhona Smith. (2003), *International Human rights*, Blackstone Press.
4	Manual of patent practice and procedure. IPR India, 2005.
5	Ministry of commerce and industry, New Delhi, pp.163.
Reference Books	
1	Trayer, P.C, Fredrick.R., and Koch, M. (2002), *Biosafety*. Michigan State University
2	Biosafety, Traylor, Fredric & Koch, 2002. Michigan state University pub., USA.
3	Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California.
4	Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333
Web Resources	
1	www.ipr-helpdesk.org/
2	www.patentoffice.nic.in/ipr/patent/patents.htm
3	www.bangalorebio.com/GovtInfo/ipr.htm

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
AVERAGE	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

DSE-II B - CANCER BIOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT5E4	**3**				**3**	**4**	**25**	**75**	**100**

Learning Objective		
LO1	The students will understand the Basics of Cancer Biology.	
LO2	The students will comprehend the Cancer at the Molecular level.	
LO3	The students will learn about the types of Cancer.	
LO4	The students will realize the different techniques of Detection and Treatment of Cancer.	
LO5	The students will know about the Prevention of Cancer.	
	Contents	**No.of Hours**
UNIT 1	Cancer: Introduction; Origin of Cancer- The Mutation Concept, The Epigenetic Concept, Viral Concept, Unified genetic concept of cancer; Difference between Normal and Cancer cells; Signs and symptoms.	15
UNIT II	Cancer as a genetic disease; Genetic Alterations in Cancer cells, Point mutation, splice mutation, alternate splicing; Mutation in regulatory sequences, deletions, Insertion, Chromosome abnormalities, Genetic defects and the time course of hereditary cancer.	15
UNIT III	Types of Cancer: - Blood & Lymph – Leukemia, Malignant lymphoma, Bone-Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumor suppressor genes; Classification of Tumor suppressor genes.	15
UNIT IV	Detection and Treatment:- Early detection, Molecular detection of Carcinomas, Cancer warning signals; Markers in blood urine; Therapies- Chemotherapy, Gene therapy, Radiotherapy, Biological therapy(Immuno therapy).	15
UNIT V	Prevention:- Tobacco smoking, sunlight, diet, ionizing radiation, alcohol drugs, promiscuity, lifestyle and cancer prevention, Environmental factors and cancer, potentially carcinogenic substances for humans.	15
Total		**75**

Text Books	
1	A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
2	Ranajit Sen,2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.
3	Dr M.R.Ahuja, 1997, Cancer- Causes and Prevention, UBS Publishers Distributors Pvt. Ltd.
4	A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
5	Ranajit Sen,2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.
Reference Books	
1	Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
2	Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.
3	Robin Hesketh, 2012, Introduction to Cancer Biology, Cambridge University Press
4	Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
5	Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.
Web Resources	
1	http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf
2	http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**15**	**14**	**15**	**15**	**15**	**15**
AVERAGE	**3**	**3**	**3**	**3**	**2.8**	**3**	**3**	**3**	**3**

Core Paper XIII - BIOENTREPRENEURSHIP

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT6C1	**4**				**4**	**6**	**25**	**75**	**100**

Learning Objective		
LO1	Students will be able to identify the challenges of being a Bioentrepreneur	
LO2	Will understand the Business proposal for starting a company	
LO3	Will learn about Vermicomposting and Sericulture	
LO4	Will aspire to set up Mushroom Cultivation	
LO5	Will learn the technique of Single cell protein Cultivation	
	Contents	**No.of Hours**
UNIT I	Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations – Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India)	**15**
UNIT II	Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. Market Conditions, Identifying the need of the customers.	**15**
UNIT III	Vermicomposting–Earthworms-Ecologicaltypes-Vermiculture-Compostpit-Vermibed-applications. Sericulture-Mulberrycultivation-SilkwormRearing-Economicsofsilkworm Production-Chawki Rearing-Sericulture in India.	**15**
UNIT IV	Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting; Mushroom diseases, Medicinal and Nutritional properties of mushroom. Aquaponics- Systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.	**15**
UNIT V	Single Cell Protein Production: Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: SPIRULINA Cultivation – Production site, Microorganism, Experimental design; harvesting and Drying.	**15**
Total		**75**
Text Books		

1	Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
2	Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.
3	The Earthworm book,Ismail,S.A.,other India Press,Goa
4	An Introduction to sericulture by G.Ganga,J.Sulochana Chetty.
5	Silk: Processing, Properties and Applications Book by K. Murugesh Babu
Reference Books	
1	Adams, D. J., & Sparrow, J. C. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
2	Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3	Desai, V.The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
4	The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Rusell
5	Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava
Web Resources	
1	https://archive.india.gov.in › citizen › agriculture
2	http://www.recirculatingfarms.org/resources/
3	https://academy.vertical-farming.net/intro-to-mushroom-growing/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**
CLO2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**3**
CLO3	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
CLO5	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
TOTAL	**15**	**13**	**10**	**14**	**10**	**13**	**15**	**15**	**15**
Average	**3**	**2.6**	**2**	**2.8**	**2**	**2.6**	**3**	**3**	**3**

Core Paper IX - PHARMACEUTICAL BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT6C2	4				4	6	25	75	100

Learning Objective		
LO1	Students will understand the series of processes involved in drug development, patenting and drug approval.	
LO2	Will learn about Biopharmaceuticals	
LO3	Will become familiar with Biotech protein drugs	
LO4	Will understand about management of drugs	
LO5	Will be familiar with Pharmaceutical sectors	
	Contents	**No.of Hours**
UNIT 1	Objectives of Pharmaceutical Biotechnology - Generic and Biogeneric drugs. Stages in the drug development process -Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials.	**15**
UNIT II	Production of recombinant proteins - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy .	**15**
UNIT III	Human Insulin (Humulin), Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab).	**15**
UNIT IV	Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management	**15**
UNIT V	National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors.	**15**
Total		**75**
Text Books		

1	Chandrakant Kokate and Pramod H.J 1st Edition (2011), Text Book of Pharmaceutical Biotechnology, Elsevier
2	Crommelin, Dean J. A., Sindelar, Robert, Meobohm, Bernd (Eds.) (2019), Pharmaceutical Biotechnology: Fundementals and Applications, Springer.
3	Ashish Dixit, Pawan Tiwari and Vivekanand Kishan Chatap (2015), Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd.
4	John F. Corpenter, Mark C. Manning (2012). *Rational Design of stable formulation Theory and Practice,* (1st edition), US: Springer Science, ISBN: 9781461351313.
Reference Books	
1	Gary Walsh (2003), Biopharmaceuticals ; biochemistry and Biotechnology, John Wiley & Sons Ltd.
2	Oliver Kayser and Heribert Warzecha (2012), Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, Wiley - Blackwell.
3	Simon Wills, 2nd Edition (2005), Drugs of abuse, Pharmaceutical Press
4	Hiten J. Gutka, Harry Yang, Shefali Kakar (2018*). Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development,* (1st ed), USA: Springer, ISBN: 978-3-319-99679-0.
5	Yui-Wing F. L. and Stuart S. (2019). *Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation,* (2nd Ed), TX, USA: Academic Press, ISBN: 9780128126264.
Web Resources	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
2	https://www.patentdocs.org/biotech_news/
3	https://www.pharmamanufacturing.com/
4	https://www.parexel.com/
5	https://nptel.ac.in/courses/102/103/102103013/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

TOTAL	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

DSE-III A -MARINE BIOTECHNOLOGY

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Instructional Hours**	**Marks**		
							CIA	**External**	**Total**
23BBT6E1	**4**				**3**	**4**	**25**	**75**	**100**

Learning Objective		
LO1	Students will gain knowledge about Marine Ecosystem and Resources.	
LO2	Will learn about bioactive compounds from Marine sources	
LO3	Will learn about medicinal seaweeds	
LO4	Will know about culture of seaweeds and Aquaculture	
LO5	Will know about Marine biotech products	
	Contents	**No. of Hours**
UNIT 1	Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea- Euphotic-Mesopelagic-Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.	15
UNIT II	Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.	15
UNIT III	Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins-antiviral and antimicrobial agents.	15
UNIT IV	Culture aspect-Seaweed (*Kappaphycus alvarezii*), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis-Polyploidy, Artificial Insemination, Eyestalk ablation- Trangenesis and Cryopreservation.	15
UNIT V	Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.	15
Total		**75**
Text Books		

1	Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
2	Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
3	Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.
4	David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
5	Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience
Reference Books	
1	Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
2	Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
3	Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
4	Gloria Sanchez, Elizabeth Hernandez,(2019*), Environmental Biotechnology and cleaner Bioprocess,* (1st edition), CRC Press, ISBN 9780367455552
5	Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3rdedition), Wiley – Blackwell.
Web Resources	
1	http://coe.genomics.org.cn/
2	http://www.bcb.iastate.edu/
3	http://www.nwfsc.noaa.gov/protocols/bioinformatics.html
4	http://www.ebi.ac.uk/ ExPASy.org/
5	http://www.expasy.org/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**3**

CLO5	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**13**	**5**	**10**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**2,6**	**1**	**2**	**3**	**3**	**3**	**3**

DSE-III B- FOOD TECHNOLOGY

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Instructional Hours**	**Marks**		
							CIA	**External**	**Total**
23BBT6E2	**4**				**3**	**4**	**25**	**75**	**100**

Learning Objective	
LO1	Students will be able to understand the basic concepts of the food industry
LO2	Will learn about classification of food
LO3	Will learn about fruits, vegetables and horticulture
LO4	Will learn about Non vegetarian food
LO5	Will learn about food adulteration and biosensors to detect them

	Contents	**No.of Hours**
UNIT 1	Biotechnology relating to the food industry – Role of bioprocess engineering in biotechnology industry- Regulatory and social aspects of biotechnology in foods- Application of biotechnology in waste treatment of food industries. Historical evolution of food processing technology.	**15**
UNIT II	Cereals and Millets. Wheat- composition, types (hard, soft/ strong, weak). Malting, gelatinization of starch, types of browning- Maillard & caramelization. Rice- and composition, parboiling of rice- advantages and disadvantages.Structure and composition of pulses, toxic constituents in pulses, processing of pulses soaking, germination, decortications, cooking and fermentation. Fats and Oils. Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.	**15**
UNIT III	Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre. Post-harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.	**15**

UNIT IV	Concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. Aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish - microbiological, physiological and biochemical. Composition and nutritive value of egg, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers. Milk and Milk Products. Chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products.	**15**
UNIT V	Types of food adulterants – test to detect adulterants in foods – metal contaminants - contaminants of processed foods- Food products as analytical samples, general aspects of biosensors- biosensors for food contaminant analysis, commercially available biosensors for food analysis. Food additivies, FSSAI regulations, Methods of fortifying and enriching foods.	**15**
Total		**75**

Text Books	
1	Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013.
2	B. Srilakshmi, Food science, New Age Publishers,2002
3	Joshi, V.K. and Singh, R.S., A. (2013), *Food Biotechnology- Principles and practices,* I.K.International Publishing House Pvt. Ltd., New Delhi,.
4	RavishankarRai, V,(2015), *Advances in Food Biotechnology*, (First edition), John Wiley & Sons, Inc, ISBN 9781118864555.
5	Perry Johnson-Green.(2018), *Introduction to Food Biotechnology*, Special Indian Edition, *CRC Press*, ISBN 9781315275703.
Reference Books	
1	Roday,S. Food Science, Oxford publication, 2011.
2	Meyer, Food Chemistry, New Age,2004 5. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007
3	Foster, G.N., (2020), *Food Biotechnology*, (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348.
4	Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin(2005), *Food Biotechnology*, (2nd edition), *CRC Press,*ISBN 9780824753290.
5	Roday,S. Food Science, Oxford publication, 2011.
Web Resources	
1	https://ifst.onlinelibrary.wiley.com/journal/13652621
2	https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-

	science/subcatid:27
3	https://www.springer.com/journal/13197
4	https://www.sciencedirect.com/referencework/9780081005965/food-science
5	https://www.ift.org/news-and-publications/food-technology-magazine

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
CLO2	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
CLO3	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
CLO4	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
CLO5	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**
TOTAL	**15**	**10**	**5**	**5**	**10**	**10**	**15**	**15**	**15**
Average	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**3**

DSE-IV A -MEDICAL BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT6E3	**4**				**3**	**4**	**25**	**75**	**100**

Learning Objective		
LO1	Student will be able to obtain knowledge on Vaccines, Antibody therapy and diagnostics	
LO2	Will know the Molecular basis of diseases	
LO3	Will know about cytokines and interferons	
LO4	Will learn about clinical trials	
LO5	Will learn about ethics in clinical trials	
	Contents	**No. of Hours**
UNIT 1	Antibodies and vaccines - Therapeutic production of antibodies, antibody mediated drug delivery of vaccines, different kind of vaccines and applications of recombinant vaccines. Diagnosis - Biochemical diagnostics, inborn errors of metabolism, haemoglobinopathies.	**15**
UNIT II	Molecular basis of disease, Recombinant DNA Technology in medicine, gene probes as molecular diagnostic reagents. Polymerase Chain Reaction in clinical diagnostics, DNA sequencing of representative clones to detect mutations.	**15**
UNIT III	Diagnosis of infectious diseases, Viral diseases – HIV, influenza; bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays. FACs immunocytochemical staining, ELISA, FISH techniques.	**15**
UNIT IV	Immunoblot analysis of antigens and allergens. Production of therapeutic agents – Productions and application of therapeutic agents, Production of cytokines and interferons.	**15**
UNIT V	Principles of project management in Clinical trials and its application. Principles of research ethics; Ethical issues in clinical trials; Animal rights and use of animals in the advancement of medical technology. Use of humans in Scientific Experiments; Introduction to ethical codes and conduct.	**15**
Total		**75**

Text Books	
1	Roli, M. (2017). *National Ethical Guidelines for Biomedical and Health Research Involving Human Participants,* ISBN: 978-81-910091-94

2	Lela, B. and Maribeth, L. F. (2011). *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications*, (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775
3	*Clinical Applications*, (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775
Reference Books	
1	Bernard, R. G. Terry, L.D. and Cherryl, L.P. (2014). *Medical Biotechnology*, (2nd edition).
2	Patrick, R.M. Kenneth, S.R. and Michael, A.P. (2016). *Medical Microbiology*, (8th edition). USA. Elsevier Publishers, eBook ISBN: 9780323388504
3	Pamela, G. Michelle, M, (2009). *Molecular Therapeutics: 21st century medicine,* (1st Edition). Hoboken, New Jersey. Wiley Publishers.
Web Resources	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/
2	https://www.nature.com/articles/s41577-021-00542-x
3	https://www.ncbi.nlm.nih.gov/books/NBK26837/
4	https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing
5	http://aquafind.com/articles/Elisa.php

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**10**	**15**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

DSE-IV B- FORENSIC BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT6E4	**4**				**3**	**4**	**25**	**75**	**100**

Learning Objective		
LO1	Students will gain insight into Forensic Biotechnology.	
LO2	Will know about various investigations protocol	
LO3	Will know about blood related issues	
LO4	Will know the use of molecular approaches to investigation	
LO5	Will understand DNA fingerprinting	
	Contents	**No.of Hours**
UNIT 1	Definition and scope of Forensic Biotechnology, History and development, Forensic genetics, Forensic agriculture.	15
UNIT II	Crime scene investigation; collection, preservation, packing and forwarding of physical and trace evidence. Questioned documents – identification of handwriting, signature and detection of forgery.	15
UNIT III	Serology - Fresh blood grouping and typing, stains of bloods. Identification of blood stains, collection and storage of allied body fluids (semen, saliva and blood). Case studies.	15
UNIT IV	PCR, RFLP, AFLP, Microscopy (Electron, Fluorescent) and Chromatography (Paper, TLC & HPLC) in forensic investigation.	15
UNIT V	DNA Profiling, Isolation of DNA from blood samples, DNA testing in cases of disputed paternity and maternity.	15
Total		**75**

Text Books	
1	Nageshkumar G Rao, Textbook of Forensic Medicine & Toxicology, Jaypee, 2013.
2	K.S. Narayan reddy and O.P. Murty, The Essentials of Forensic Medicine & Toxicology, 35th Edition, Jaypee, 2017.

3	Nanda, B.B. and Tiwari R. K. (2014). Forensic Science in India: A Vision for the Twenty First Century, (2nd edition), Select Publishers, New Delhi, ISBN: 9788190113526.
4	Barbara H. Stuart (2013). Forensic Analytical Techniques (Analytical Techniques in the Sciences (AnTs), (1st edition), UK, Wiley, ISBN: 978-0-470-68727-7.
5	C. Champod, C. Lennard, C. Margot, P. and Stoilovic (2015). Fingerprints and otherRidge Skin Impressions, (7th edition), Boca Raton, CRC Press, ISBN: 9781498728959.
Reference Books	
1	Jim Fraser, " Forensic Science: A very short introduction", Oxford university press, 2010.
2	William Goodwin, Adrian Linacre, SibteHadi, "An introduction to Forensic Genetics", John Wiley & Sons Ltd 2007.
3	Harralson H. and Miller S. (2017). *Huber and Headrick's Handwriting Identification: Facts and Fundamentals,* (2nd Edition), Boca Raton, CRC Press, ISBN: 9781498751308.
4	Ghosal S. and Avasthi A.S. (2018). *Fundamentals of Bioanalytical Techniques and Instrumentation,* (2nd Edition), Delhi, PHI, ISBN: 9789387472396.
Web Resources	
1	http://www.forensicsciencesimplified.org
2	www.nfstc.org
3	https://archive.org/details/FBI_Handbook_of_ForensicScience
4	https://www.soinc.org/forensics-notes

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
TOTAL	**15**	**15**	**15**	**10**	**15**	**15**	**15**	**15**	**15**
Average	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

DSE- IV C -GOOD LABORATORY PRACTICES

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
23BBT6E5	**4**				**3**	**4**	**25**	**75**	**100**

Learning Objective		
LO1	The student will know the types of labs associated with Biotechnology	
LO2	Will know to use and maintain lab Instruments	
LO3	Will know the calculations needed in a laboratory	
LO4	Will know about good lab Guidelines	
LO5	Will know how to safely dispose bio waste	
	Contents	**No. of Hours**
UNIT 1	Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.	15
UNIT II	Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).	15
UNIT III	Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation.	15
UNIT IV	Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.	15

UNIT V	Definition of waste, types of waste: Biological andchemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel.	15
Total		**75**

Text Books

1	WHO training manual on Good Laboratory Practices, 2nd Edition.
3	
1	Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.

Web Resources

1	https://www.who.int/tdr/publications/documents/glp-trainer.pdf"tdr
2	https://www.who.int/tdr/publications/documents/glp-trainer.pdf"›publications › documents
3	https://www.who.int/tdr/publications/documents/glp-trainer.pdf"glp
4	https://www.who.int/tdr/publications/documents/glp-trainer.pdf"-trainer
5	www.who.int/tdr/publications/documents/glp-handbook.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	2	2	3	3	3	3
CLO2	3	3	3	2	2	3	3	3	3
CLO3	3	3	3	2	2	3	3	3	3
CLO4	3	3	3	2	2	3	3	3	3
CLO5	3	3	3	2	2	3	3	3	3
TOTAL	15	15	15	10	10	15	15	15	15
AVERAGE	3	3	3	2	2	3	3	3	3

<table>
<tr><td>Title of the Course</td><td colspan="6">ESSENTIAL REASONING AND QUANTITATIVE APTITUDE</td></tr>
<tr><td>Paper Number</td><td colspan="6">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">PCS</td><td>Year</td><td>III</td><td>Credits</td><td>2</td><td>Course Code
23BBT6S1</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td>1</td><td colspan="2">1</td><td>-</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="5">• Develop Problem solving skills for competitative examinations
• Understand the concepts of averages , simple interest , compound interest</td></tr>
<tr><td colspan="2">UNIT-I:</td><td colspan="5">Quantitative Aptitude: Simplifications=averages-Concepts –problem-Problems on numbers-Short cuts- concepts –Problems</td></tr>
<tr><td colspan="2">UNIT-II:</td><td colspan="5">Profit and Loss –short cuts-Concepts –Problems –Time and work - Short –uts -Concepts -Problems.</td></tr>
<tr><td colspan="2">UNIT-III:</td><td colspan="5">Simple interest –compound interest- Concepts- Prolems</td></tr>
<tr><td colspan="2">UNIT-IV:</td><td colspan="5">Verbal Reasoning : Analogy- coding and decoding –Directions and distance –Blood Relation</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="5">Analytical Reasoning :Data sufficiency
Non-Verbal Reasoning : Analogy ,Classification and series</td></tr>
<tr><td colspan="2"></td><td colspan="5"></td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="5">Studnets relating the concepts of compound interest and simple interest</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="5">1.”Quantitative Aptitude” by R.S aggarwal ,S.Chand & Company Ltd 2007</td></tr>
<tr><td colspan="2"></td><td colspan="5"></td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="5">https://nptel.ac.in</td></tr>
</table>