

SENGUNTHAR ARTS AND SCIENCE COLLEGE

(Autonomous)

(Affiliated to Periyar University, Salem and Approved by AICTE, New Delhi)

An ISO 9001:2015 Certified Institutions.

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TIRUCHENGODE-637205, NAMAKKAL DT., TAMIL NADU

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SYLLABUS

B.Sc., BIOTECHNOLOGY

(CBCS – LOCF)

(With effects from Academic Year 2024-2025 onwards)

Chairman

CDC

PRINCIPAL

CORRESPONDENT

INTRODUCTION

Biotechnology is one of the youngest branches of Life Science, which has expanded and established as an advanced interdisciplinary applied science in last few years. Biotechnology at the core envisages the comprehensive study of Life and the Interdisciplinary potential of Biotechnology has led to unique status for Biotechnology in Research and Industry. Biotechnology can be applied in developing various vaccines, medicines and diagnostics, improving energy production and conservation and increasing productivity in Industry, Agriculture, Health and Environment. The syllabi for the three – year B.Sc., Degree course in Biotechnology are framed in such a way at the end of the course can be adopt knowledge about the theoretical development of Biotechnology.

AIM

The syllabus of this program is aimed at preparing the students with the latest developments and put them on the right track to fulfil the present requirements.

ELIGIBILITY FOR ADMISSION FOR THE COURSE:

Candidates for admission to the first year of the Degree of Science in Biotechnology (UG) course shall be required to have passed Higher Secondary Examination in any one of the biological sciences (Botany, Zoology, Biology, Academic/Vocational stream-Agri, Home Science and Poultry) under higher secondary board of examination, Tamil Nadu or an examination accepted as equivalent there to by the Governing body of the institution to such conditions as may be prescribed there to are appear and qualify for the B.Sc., Biotechnology degree examination of the university after a course of the study of three years.

PROGRAMME OUTCOMES

REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDER GRADUATE	
Programme:	B.Sc. BIOTECHNOLOGY
Programme Code:	24UBT
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 under graduate 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; analyze 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 extra polite from what one has learned and applies 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 their liability 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, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define

	problems, formulate hypotheses, test hypotheses, analyze, 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 respect fully 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 analyze interprets and draws conclusions from quantitative/qualitative data; and critically evaluates ideas, evidence and experiences 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.
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Programme Specific Outcomes (PSO)

Programme Specific Outcomes (PSOs)	On successful completion of Bachelor of Biotechnology Programme, the student should be able to: PSO1: Disciplinary Knowledge: Understand the fundamental principles, concepts, and theories related to biotechnology. Also, exhibit proficiency in performing experiments in the laboratory. PSO2: Critical Thinking: Analyze 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 reasoning ability 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 analyze data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models. PSO5: Research related skills: Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.
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	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Level of Correlation between POs and PSOs (*Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix*);

1 – Low, 2 – Medium, 3 – High, 0 – No Correlation

FIRST YEAR

SEMESTER- I

S. No	Course Content	Paper code	Title of the paper	Ins Hrs		Credits	Int. Marks	Ext. Marks	Total
				T	P				
1	Part-I Language	24S1UFTA01	Podhu Tamil – I	6	-	3	25	75	100
2	Part- II Language I	24S1UFEN01	General English- I	6	-	3	25	75	100
3	Part-III Core-I	24S1UBT01	Core Paper I-Cell and Developmental Biology	4	-	4	25	75	100
4	Part-III Core -II	24S1UBT02	Core paper-II Molecular Biology	3	-	3	25	75	100
5	Part-III Core Practical-I	24S1UBTP01	Core practical - I-Cell and Molecular Developmental Biology and Biological Chemistry	-	4	3	40	60	100
6	Part-III Generic Elective - I	24S1UBTE01	Elective –I Biological Chemistry	3	-	3	25	75	100
7	Part IV NME-I	24S1UBTN01	Food Nutrition	2	-	2	25	75	100
		24S1UBTN02	Public Health and Hygiene						
		24S1UBTN03	Agriculture Biotechnology						
8	Part IV Foundation Course -I	24S1UBTF01	Mushroom Cultivation Technology	2	-	2	25	75	100
Total				30	4	23	215	585	800

FIRST YEAR

SEMESTER- II

S. No	Course Content	Paper code	Title of the paper	Ins Hrs		Credits	Int. Marks	Ext. Marks	Total
				T	P				
1	Part–I Language	24S2UFTA02	Podhu Tamil- II	6	-	3	25	75	100
2	Part- II Language	24S2UFEN02	General English –II	6	-	3	25	75	100
3	Part-III Core-III	24S2UBT03	Core Paper - III Genetics	5	-	5	25	75	100
4	Part-III Core-IV	24S2UBT04	Core paper - IV Human Physiology	2	-	2	25	75	100
5	Part-III Generic Elective-II	24S2UBTE02	Elective - II Fundamentals of Microbiology	3	-	3	25	75	100
6	Part-III Core Practical- II	24S2UBTP02	Core Practical II– Genetics and Microbiology	-	4	3	40	60	100
7	Part IV NME-II	24S2UBTN04	Organic farming and Health Management	2	-	2	25	75	100
		24S2UBTN05	Biotechnology for Society						
8	Part IV Skill Enhancement Course(SEC)-I	24S2UBTS01	Vermicompost Technology	2	-	2	25	75	100
		24S2UBTS02	Seed Technology						
				30	04	23	215	585	800

SECOND YEAR

SEMESTER – III

S. No	Course Category	Course code	Title of Course	Hrs/ week		Credit Point	Max Marks		
				T	P		CIA	ESE	Total
1	Part – I Language	24S3UFTA03	Podhu Tamil – III	6	-	3	25	75	100
2	Part – II Language	24S3UFEN03	General English- III	6	-	3	25	75	100
3	Part – III Core V	24S3UBT05	Core Paper V- Immune system and Immuno technology	4	-	5	25	75	100
4	Part – III Core VI	24S3UBT06	Core VI- Clinical biotechnology	3	-	2	25	75	100
5	Part – III Generic Elective -III	24S3UBTE03	Elective -III Bioinformatics and Biostatistics	3	-	3	25	75	100
6	Part – III Core Practical III	24S3UBTP03	Practical III – Immuno technology, Bioinformatics and biostatistics	-	4	3	40	60	100
7	Part – IV SEC II	24S3UBTS03	DNA Typing in Forensic	1	-	1	25	75	100
		24S3UBTS04	Quality control in industries						
8	Part – IV SEC III	24S3UBTS05	Sericulture	2	-	2	25	75	100
		24S3UBTS06	Medicinal herbs						
9			*Environmental Studies	1	-	-	-	-	-
Total				26	4	22	215	585	800

- Evs Examination will be held in IV Sem

SECOND YEAR

SEMESTER – IV

S.No	Course Category	Course code	Title of Course	Hrs/ week		Credit Point	Max Marks		
				T	P		CIA	ESE	Total
1	Part – I Language	24S4UFTA04	Podhu Tamil – IV	6	-	3	25	75	100
2	Part – II Language	24S4UFEN04	General English- IV	6	-	3	25	75	100
3	Part – III Core VII	24S4UBT07	Core Paper VII - Genetic Engineering	6	-	6	25	75	100
4	Part – III Elective IV	24S4UBTE04	Elective IV - Bioinstrumentation	3	-	3	25	75	100
5	Part – III Core Practical III	24S4UBTP04	Core Practical IV Lab in Genetic Engineering and Bioinstrumentation	-	4	4	40	60	100
6	Part – IV SEC IV	24S4UBTS07	Fundamentals in Research Methodology	2	-	2	25	75	100
		24S4UBTS08	Finger Prints and Examined						
7	Part – IV SEC V	24S4UBTS09	Cryogenics and cryobiology	2	-	2	25	75	100
		24S4UBTS10	Hatchery Management						
8	Part -IV	24S4UES01	Environmental Studies	1	-	2	25	75	100
9	Part – IV		▪ Internship	-	-	-	-	-	-
Total				26	4	25	215	585	800

- Students Undergo summer Vacation for 2 weeks

THIRD YEAR

SEMESTER - V

S.No	Course Category	Course code	Title of Course	Hrs/ week		Credit Point	Max Marks		
				T	P		CIA	ESE	Total
1	Part-III Core paper VII	24S5UBT08	Core Paper VIII Plant Biotechnology	5	-	4	25	75	100
2	Part-III Core paper IX	24S5UBT09	Core Paper IX Animal Biotechnology	5	-	4	25	75	100
3	Part-III Core practical V	24S5UBTP05	Core Practical V – Plant Biotechnology	-	4	3	40	60	100
4	Part-III Core practical VI	24S5UBTP06	Core Practical VI – Animal Biotechnology	-	4	3	40	60	100
5	Part-III Elective paper V	24S5UBTE05	* Nano Biotechnology	4	-	3	25	75	100
		24S5UBTE06	* Enzymology and Enzyme technology						
		24S5UBTE07	* Pharmaceutical Biotechnology						
6	Part-III Elective paper VI	24S5UBTE08	* Biofarming	4	-	3	25	75	100
		24S5UBTE09	* Bioethics, Biosafety and IPR						
		24S5UBTE10	* Dairy science and technology						
7	Part III Project	24S5UBTPR01	■ Project	-	2	2	25	75	100
8	Part IV Internship	24S5UBTI01	■ Internship	-	-	2	-	-	-
9	Part V	24S5UVE01	Value Education	2		2	25	75	100
Total				20	10	26	330	570	800

* Choose any one Elective

■ Students undergo summer vacation after IV Semester for 2 weeks.

THIRD YEAR

SEMESTER – VI

S.No	Course Category	Course code	Title of Course	Hrs/ week		Credit Point	Max Marks		
				T	P		CIA	ESE	Total
1	Part-III Core paper X	24S6UBT11	Core Paper X Entrepreneurship Biotechnology	5	-	3	25	75	100
2	Part-III Core paper XI	24S6UBT12	Core paper XI Environmental and Industrial Biotechnology	5	-	3	25	75	100
3	Part-III Core paper XII	24S6UBT13	Core paper XII Stem cell technology and Tissue engineering	4	-	3	25	75	100
4	Part-III Core practical VII	24S6UBTP07	Core Practical VII – Environmental and Industrial Biotechnology	-	4	3	40	60	100
5	Part-III Elective paper VII	24S6UBTE11	* Marine science and technology	5	-	3	25	75	100
		24S6UBTE12	* Food science and technology						
		24S6UBTE13	* Cancer Biology						
6	Part-III Elective paper VIII	24S6UBTE14	* Medical Biotechnology	5	-	3	25	75	100
		24S6UBTE15	* Forensic science and technology						
		24S6UBTE16	* Good Laboratory Practices						
7	Part IV	24S6UBTS11	Skill Based Paper For Competitive Examination	2	-	2	25	75	100
8	Part V	24S6UEX01	Extension Activities	-	-	1	100		100
Total				26	04	21	215	585	800

* Choose any one Elective

SEMESTER – I

FIRST YEAR - SEMESTER – I

CORE-I: CELL AND DEVELOPMENTAL BIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBT01	Core-I	Theory	Y	Y	-	4	4

Learning Objectives

- ❖ 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, Transcription and Translation and post translational modifications of proteins.
- ❖ Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways.
- ❖ Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Understanding the prokaryotic and Eukaryotic cell.	PO1
CO2	Discussing in detail the cell membrane and function.	PO1,PO2
CO3	Overview of the central dogma of life and various molecular events Learning molecular events in the DNA replication and role of different enzymes-Molecular Events Translation leading to protein synthesis and Post translational modification.	PO4,PO6
CO4	Compare and contrast the events of cell cycle and its regulation Gaining knowledge for cell to cell signaling.	PO4,PO5,PO6
CO5	Understands the students about sequential changes from single cell organization to organ level in the development of multicellular organisms.	PO3,PO8

Unit	Details	No. of Hours
I	Discovery and Variation of cells: Cell theory, Prokaryotic Cellular Organization (bacteria) and Eukaryotic Cellular Organization (plant and animal cells). *Model Preparation- (Plant and Animal Cell)	12
II	Biomacromolecules and Biomicromolecules (Primary Function in the Cell) Structure and Functions - Cell wall - Cell membrane -Cytoplasm - Nucleus - chromosomes - Endoplasmic reticulum - Ribosome's -Golgi bodies-Vacuoles- Lysosomes-Mitochondria-Micro bodies- Flagella- Cilia- Centrosome, Centrioles and Chloroplast. Structure and Function of Cytoskeleton.	12
III	Cell cycle: Cell cycle - Cell division - Mitosis and Meiosis – Apoptosis and Senescence- Cellular differentiation - Cell junctions - Cell Adhesion - Extracellular Matrix –Cell to cell communications- Signal transduction-G-Protein Coupled Receptors Signal transduction pathways. * Power Point Presentation on Cell Division(Animation)	12
IV	Specialised cells: Motile cells (Amoeboid, Ciliary, Flagellar Movements, Nerve cells and Nerve impulse conduction, Muscle cells and Muscle contraction, Plant cells (Parenchyma cells, Xylem and Phloem Cells).	12
V	Gametogenesis: Spermatogenesis and Oogenesis in mammals. Fertilization-Types of cleavage, blastula formation, gastrulation and formation of germ layers in animals-Organogenesis (Frog).	12
	Total	60
* Model Preparation and Power Point Presentation - related to the above topics are to be Considered for Internal Exam only		

Text Books

- ❖ T.Devasena (2016), Cell Biology, Oxford University Press.
- ❖ Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018).Cell Biology: Practical Manual.
- ❖ Gilbert, S.F. 2016.Developmental Biology, 11th edition. Sinauer Associates Inc .Publishers, MA. USA
- ❖ Bruce Alberts, 6thEdition (2016).Molecular Biology of the cell, W.W.Norton & Company.
- ❖ James D.Watson (2020), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.
- ❖ Pijushroy.,2019,PlantAnatomy,NewCentralBookAgency,PutLit.,NewDelhi

Reference Books

- ❖ Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.
- ❖
- ❖ James D. Watson, 7th Edition (2015), Molecular Biology of the Gene, Pearson Publications.
- ❖ Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Oxford University Press.
- ❖ Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
- ❖ Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.

Web Resources

- ❖ <http://www.cellbiol.com/education.php>
- ❖ <https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/>
- ❖ <https://dnalc.cshl.edu/websites/>
- ❖ <https://www.cellsignal.com/contents/science/cst-pathways/science-pathways>
- ❖ <https://nptel.ac.in/courses/102/106/102106025/11>.

MAPPING WITH PROGRAMME OUT COMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	2	1	3	-	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	-	3	3	2	3	2	2	3	3	2	3
CLO3	3	3	3	2	-	3	3	2	2	3	2	3	3	3	3
CLO4	3	2	3	2	-	3	2	3	3	2	2	3	2	3	2
CLO5	3	3	2	2	-	3	3	2	3	2	3	3	3	3	3
Total	15	14	12	12	0	15	13	12	13	12	12	15	14	14	13
Average	3	2.8	2.4	2.4	0	3	2.6	2.4	2.6	2.4	2.4	3	2.8	2.8	2.6

CORE PAPER II –MOLECULAR BIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBT02	Core-II	Theory	Y	Y	-	3	3

Learning Objectives

- ❖ Know about basics structure of DNA and RNA, and Organization of genes in prokaryotes & Eukaryotes. Gain knowledge about replication in Prokaryotes & Eukaryotes and role of enzymes in replication
- ❖ Understand the gene expression by Translation and Transcription process and regulation of gene expression.
- ❖ Know about the Mutation, their types and repair mechanism
- ❖ Understand the Genetics exchanges in microbes
- ❖ Know about basics structure of DNA and RNA, and Organization of genes in prokaryotes & Eukaryotes. Gain knowledge about replication in Prokaryotes & Eukaryotes and role of enzymes in replication.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Gain knowledge on the structure and characters of Genetic materials.	PO1
CO2	Understand replication of DNA.	PO1,PO2
CO3	Learn transcription and translation process in prokaryotes and Eukaryotes.	PO4,PO6
CO4	Perceive Genetic alterations and their repair mechanisms.	PO4,PO5,PO6
CO5	Understand the methods of genetic exchange.	PO3,PO8

Unit	Details	No. of Hours
I	Basic Concepts of genome and its Organisation: Nucleic acid as the genetic material (Griffith's experiment, Avery) and Characters of a genetic material. Watson and Crick model of DNA structure, A, B & Z forms of DNA. Structure and types of RNA. Organization of Gene in Prokaryotes. Bacterial Chromosome *Model Preparation – (DNA & RNA Structure)	9
II	DNA replication & Enzymology: DNA replication, Prokaryotic replication, replication Mechanism and Enzymology, replication itself and rolling circle replication.	9
III	RNA synthesis and Processing: Prokaryotic Transcription, Post Transcriptional changes; Genetic code; Protein Translation, Post Translational Modifications. Operon concept: Regulation of gene expression in Prokaryotes: lac & trp Operon. *Power Point Presentation on Translation(Animation)	9
IV	DNA Mutation and Repair: Mutation-spontaneous and induced Mutagen & Mutagenesis–DNA repair Mechanism.	9
V	Genetic Exchange –Transduction (specialized & generalized Transformation, Conjugation-Hfr mapping, genetic recombination	9
	Total	45
* Model Preparation and Power Point Presentation - related to the above topics are to be Considered for Internal Exam only		

Text Books

- ❖ Gardner,E. J,Simmons,M J&D P Snustard ,2019 , Principles of Genetics, 8th edition. John Wiley & Sons. NY
- ❖ RobertH.Tamarin.PrinciplesofGenetics,5th edition, 2019, WmC Brown Publishers.

Reference Books

- ❖ Lewin.B, 1990. Genes, 6thedition, Oxford University Press.
- ❖ Klug. W. S.& Cummings, MR, 1996,EssentialsofGenetics, Mentics Hail. New Jersey.

Web Resources

- ❖ <https://www.youtube.com/watch?v=0lZRAShqft0>
- ❖ https://www.youtube.com/watch?v=JQByjprj_mA
- ❖ <https://www.zmescience.com/medicine/genetic/dna-replication-steps-43264/#>
- ❖ <https://www.youtube.com/watch?v=NGLuO-NYRug>
- ❖ <https://www.youtube.com/watch?v=a48GfC0ygpg>
- ❖ <https://www.youtube.com/watch?v=0lZRAShqft0>

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC
OUTCOME**

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	2	1	3	-	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	-	3	3	2	3	2	2	3	3	2	3
CLO3	3	3	3	2	-	3	3	2	2	3	2	3	3	3	3
CLO4	3	2	3	2	-	3	2	3	3	2	2	3	2	3	2
CLO5	3	3	2	2	-	3	3	2	3	2	3	3	3	3	3
Total	15	14	12	12	0	15	13	12	13	12	12	15	14	14	13
Average	3	2.8	2.4	2.4	0	3	2.6	2.4	2.6	2.4	2.4	3	2.8	2.8	2.6

Course Coordinator

BOS Chairman

ELECTIVE I – BIOLOGICAL CHEMISTRY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTE01	ELECTIVE I	Theory	Y	Y	-	3	3

Learning objectives

- ❖ Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding.
- ❖ Demonstrates the formation of different types of solutions, concentrations of solutions and preparation of buffer solutions
- ❖ Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism
- ❖ Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism
- ❖ Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To make students have a strong foundation in chemical biology.	PO1
CO2	To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions	PO1,PO2
CO3	To correlate Biochemical process with biotechnology applications	PO4,PO6
CO4	To discuss the significance of various metabolic processes occurring in biological system	PO4,PO5,PO6
CO5	To evaluate of both Hormones and Enzymology and also its medical importance in the human life.	PO3,PO8

Unit	Details	No. of Hours
I	Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbital's. Types of chemical bonds. Classification of organic compounds. Hybridization in methane, ethane, acetylene, and benzene. *Power Point Presentation on Classification of organic compounds	9
II	Biochemical Techniques: Characteristics and differences of acids and bases, Concepts of acids and bases-Arrhenius, Lowry Bronsted and Lewis. Solution concentration and its various expressions, such as percent by weight, normalcy, molarity, molality, and mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation.	9
III	Metabolic Pathways: Classification of carbohydrates. Properties of carbohydrates. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Glycolysis, Gluconeogenesis TCA cycle, bioenergetics of carbohydrate metabolism. *Poster Preparation on Any Cycle	9
IV	Lipids: Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, phospholipids, cholesterol. B-oxidation of fatty acids.	9
V	Amino acids: Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins (Biological functions, daily requirements, deficiency symptoms and diseases-Structure not required) and Hormones.	9
	Total	45
*Poster Preparation and Power Point Presentation - related to the above topics are to be Considered for Internal Exam only		

Text Books

- ❖ P.L.Soni, A Text-book of Inorganic Chemistry, 12th Edition, 2015, S. Chand & Sons publications
- ❖ Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition
- ❖ J. L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.
- ❖ A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.

Reference Books

- ❖ Lehninger (2013) Principles of Biochemistry 4th edition WH Freeman and Company.
- ❖ Murray *et al.*, (2003) Harper's biochemistry 26th edition Appleton and Lange Publishers Florida USA.
- ❖ Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W. C. Brown Publishers, 1995, 3rd edition.
- ❖ Lubert Stryer (2007) Biochemistry–Stanford University 5th Edition–W H Freeman and company San Francisco.
- ❖ Bahl Arun, Bahl B.S. (2016), A Text book of Organic Chemistry, 22nd Edition, S. Chand & Sons publications

Web Resources

- ❖ <http://dwb4.unl.edu/chem869p/chem869links/s>
- ❖ www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp
- ❖ <https://www.britannica.com/science/biochemistry>
- ❖ <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences>
- ❖ <https://biochemistry.org> > education > careers > becoming-a-bioscientist

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	1	3	2	2	2	3	2	3	3	3	3	3	2
CLO2	3	2	1	3	2	2	3	2	3	2	2	3	3	2	3
CLO3	3	1	2	3	2	2	3	2	2	3	2	3	3	3	3
CLO4	3	2	3	3	2	1	2	3	3	2	2	3	2	3	2
CLO5	3	2	3	2	2	2	3	2	3	2	3	3	3	3	3
Total	15	10	10	14	10	9	13	12	13	12	12	15	14	14	13
Average	3	2	2	2.8	2	1.8	2.6	2.4	2.6	2.4	2.4	3	2.8	2.8	2.6

CORE PRACTICAL - I
CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY AND
BIOLOGICAL CHEMISTRY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTP01	Core Practical-I	Practical	-	-	Y	4	3

Learning Objectives

- ❖ Demonstrate the operation of Light Microscope Identify blood cells and its components
- ❖ Isolate and identify plant, and animal cells. Summarizes the concept of gametes
Develop skill to perform cell fractionations
- ❖ Perform and estimate the amount of chemical substance present in a solution qualitatively. To analyze and detect the nature of various organic class of compounds qualitatively
- ❖ Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests. Differentiate the carbohydrates based microscopic examination of the crystal. Understand the methods of acidimetry, alkalimetry and permanganometry.
- ❖ Quantify Ascorbic acid in lemon by Dichloro phenol indo phenol dye method, Glycine by sorensens formal titration method. Estimate Glucose, Cholesterol and Proteins.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Find out the various stages of Cell division Sex chromatin determination by performing a Barr body experiment.	PO1
CO2	To know the different stages of chick embryo.	PO1,PO2
CO3	To analyse the organic compounds present in the cell.	PO4,PO6
CO4	To know the components in unknown sample.	PO4,PO5,PO6
CO5	To calculate the unknown concentration of a solution.	PO3,PO8

Unit	Details	No. of Hours
I	CELL BIOLOGY 1. Microscopes and its parts. 2. Blood smear preparation and Identification of Blood cells 3. Buccal smear preparation and Identification of squamous epithelial cells.	15
II	4. Micrometry - Stage and Ocular Micrometer. 5. Mitosis in Onion root tip squash 6. Meiosis in grasshopper testis / flower buds. 7. Cell fractionation and Identification of cell organelles (Demo) 8. Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.	10
III	BIOLOGICAL CHEMISTRY Systematic analysis of Organic compounds 9. Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde)	10
IV	Qualitative Analysis 10. Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch. 11. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline	10
V	Colorimetric Analysis 12. Estimation of glucose- Ortho toluidine method 13. Estimation of Cholesterol- Zak's method 14. Estimation of proteins – Lowry's method	15
Total		60

Text Books

- ❖ K. V. Chaitanya, (2016), Cell and molecular biology: Lab manual, PHI publishers,. ISBN978-81-203-800-4
- ❖ J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2018.
- ❖ S.K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2015.

Reference books

- ❖ Dr. OP Panday, DN Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016.
- ❖ Hands Thacher Clarke, A hand book of Organic: Qualitative and quantitative Analysis, 2007.
- ❖ N. S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME
SPECIFIC OUTCOME**

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	2	3	2	3	2	3	3	2	2	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	2	2	2	3
CLO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	3	2	3	2	2	3	2	3	2	2	3	3	3	3
Total	15	14	14	15	13	14	13	12	13	12	14	13	13	14	13
Average	3	2.8	2.8	3	2.6	2.8	2.6	2.4	2.6	2.4	2.8	2.6	2.6	2.8	2.6

Course Coordinator

BOS Chairman

NON MAJOR ELECTIVE 1 (Offered to other dept)**FOOD NUTRITION**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTN01	NON MAJOR ELECTIVE 1	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ The student can determine the relationship between food, health and immunity
- ❖ Able to explain the classification of foods and their deficiency
- ❖ Can analyze the importance of BMR
- ❖ Can outline the basic food groups and their adulteration
- ❖ Apply the concepts of food to prepare different food plans

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Learn about nutrition and their importance	PO1
CO2	To know about the classification of nutrients and its deficiency	PO1,PO2
CO3	To analyze the BMR	PO4,PO6
CO4	To know about the basic food groups and adulteration	PO4,PO5,PO6
CO5	To learn the knowledge of principles and objectives of meal planning	PO3,PO8

Unit	Details	No. of Hours
I	Diet, Health and Nutritional Status: Food definition, nutritional status, nutrient balance, dietetics, malnutrition, and nutrition Energy (Joule, Kilocalorie units of measurement). Health, food-induced immunity, and the role of diet. *Power Point Presentation on Diet, Health and Nutritional	6
II	Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine)-Sources, Classification, Function and Deficiencies of these nutrients. Function of water and dietary fiber.	6
III	BMR(Basal Metabolic Rate): Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals) *Field Visit to Fitness Center and Report Submission	6
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, Safety measures in food handling, Food adulteration, food Preservatives and food Packaging.	6
V	Principles and Objectives of meal planning. Diet planning for different age groups (infant, school children, adults and old age)	6
Total		30
* Power Point Presentation and Field Visit - related to the above topics are to be Considered for Internal Exam only		

Text Books

- ❖ Vidya & D.B. Rao, 2018. A text book of nutrition by, Discovery Publishing house,
- ❖ Hand book of Nutrition & Food, third edition, CRC Press (Taylor and Francis group) by Carolyn D. Berdanier- 2018
- ❖ Food science and Nutrition, Oxford publication by Sunetra Roday - 2021
- ❖ Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press.

Reference Books

- ❖ Joshi, V.K. and Singh, R. S., A. (2013), Food Biotechnology-Principles and practices.
- ❖ I.K. International Publishing House Pvt. Ltd., New Delhi.
- ❖ Ravi Shankar Rai, V, (2015), Advances in Food Biotechnology, (First edition), John Wiley & Sons, Inc, ISBN 9781118864555
- ❖ Foster, G. N., (2020), Food Biotechnology, (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348
- ❖ Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin (2005), Food Biotechnology, (2nd edition), CRC Press, ISBN 9780824753290

- ❖ Perry Johnson-Green (2018), Introduction to Food Biotechnology, Special Indian Edition, CRC Press, ISBN 9781315275703

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME
SPECIFIC OUTCOME**

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	2	1	1	3	2	2	3	2	3	3	3	3	3	2
CLO2	3	2	1	1	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	2	1	1	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	2	1	1	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	2	1	1	3	3	3	2	3	2	3	3	3	3	3
Total	15	10	5	5	15	14	13	12	13	12	15	15	15	14	13
Average	3	2	1	1	3	2.8	2.6	2.4	2.6	2.4	3	3	3	2.8	2.6

Course Coordinator

BOS Chairman

NON MAJOR ELECTIVE 1**HEALTH AND HYGIENE**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTN02	NON MAJOR ELECTIVE 1	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ 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

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Learn about public health and hygiene	PO1
CO2	Gain knowledge and understanding of the wider determinants of health and ill-health	PO1,PO2
CO3	To know awareness of the debates and dilemmas that may arise from the promotion of publichealth.	PO4,PO6
CO4	To learn some knowledge and understanding of the roles of people and agencies who undertakework in the promotion of public health	PO4,PO5,PO6
CO5	Gain knowledge on health problems to develop solutions	PO3,PO8

Unit	Details	No. of Hours
I	Health and hygiene – What is Health and Hygiene - Relation between health , hygiene & Health sanitation. Relevance & importance of health, hygiene in the contemporary times. Personal hygiene, oral hygiene and sex hygiene. *Poster Preparation on Importance of health and hygiene	6
II	Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkor, Marasmus, Rickets, Goiter (cause, symptoms, precaution and treatment).	6
III	Communicable viral diseases- measles, poliomyelitis, flu, dengue, chickengunya, rabies and hepatitis, COVID. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, diphtheria, leprosy. *Power point Presentation : Emerging communicable disease	6
IV	Non-communicable diseases: hypertension, stroke, coronary heart disease, myocardial infarction. Cardiovascular Diseases, Cancer, Respiratory Diseases, Diabetes	6
V	Health Services Organizations: World Health Organization (WHO), United Nations International Children’s Emergency Fund (UNICEF) and Indian Red Cross (IRC).	6
Total		30
*Poster Preparation and Power Point Presentation - related to the above topics are to be Consider for Internal Exam only		

Text Books

- ❖ Mary Jane Schneider (2017) Introduction to Public Health.
- ❖ Muthu, V. K. (2019) A Short Book of Public Health.
- ❖ Detels, R. (2017) Oxford Text book of Public Health (6th edition).
- ❖ Gibney, M .J. (2018) Public Health Nutrition.
- ❖ Wong, K.V. (2017) Nutrition, Health and Disease.

Reference Books

- ❖ S. Lal, (2018), Vikas. Public Health Management Principles And Practice, 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.
- ❖ Mary-Jane Schneider (2016), Introduction to Public Health,(5th Edition), Jones & Bartlett Learning, ISBN-13: 978-1284197594
- ❖ Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), Hand book of Nutrition and Food, (3rd Edition), CRC Press, ISBN 9781466505711.
- ❖ Sue Reed, Dino Pisaniello, Geza Benke, Kerrie Burton. (2013), Principles of

Occupational Health and Hygiene: An Introduction, (2nd Revised ed. Edition),
Allen & Unwin,

- ❖ V.Kumaresan, R. SornaRaj, (2012) Public Health and Hygiene, (1stEdition),
Saras Publication.

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME
SPECIFIC OUTCOME**

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	-	2	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	-	2	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	1	2	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	1	2	3	3	2	3	3	2	3	3	3	3	2
CLO5	2	3	2	3	3	3	3	2	3	2	2	2	3	3	3
Total	14	15	4	11	15	15	13	12	13	12	14	14	15	14	13
Average	2.8	3	0.8	2.2	3	3	2.6	2.4	2.6	2.4	2.8	2.8	3	2.8	2.6

Course Coordinator

BOS Chairman

NON MAJOR ELECTIVE 1
AGRICULTURAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTN03	NON MAJOR ELECTIVE 1	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ The student can determine the increasing productivity
- ❖ To understand the improving nutritional quality.
- ❖ To understand developing crops with resistance or tolerance to biotic and abiotic stresses.
- ❖ To understand the biotechnological approaches used to improve animal and plant productivity and disease control.
- ❖ Students will understand and analyze the current events and issues that are occurring in agriculture and how they affect your future in agriculture.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To understand the basic concept of agriculture	PO1
CO2	To understand the Molecular basis of plant resistance to various abiotic stresses	PO1,PO2
CO3	To Know about Plant Growth promoting bacteria	PO4,PO6
CO4	To understand the Production of transgenic plants and applications	PO4,PO5,PO6
CO5	To understand the Bioethical issue on GM crops	PO3,PO8

Unit	Details	No. of Hours
I	Agriculture: Introduction to Agriculture, Scope and application of agriculture. Crop improvement hybridization and plant breeding techniques *Model Preparation - Plant Breeding	6
II	Plant Resistance: Molecular and biochemical basis of plant disease resistance, Molecular basis of plant resistance to various abiotic stresses like drought, salinity, heavy metals, high temperature	6
III	Plant growth promoting microorganisms: Plant Growth promoting bacteria: Nitrogen fixation - Nodulation genes and Nif genes. Biofertilizers: Azolla and Anabena, Rhizobium, Phosphate solubilizing bacteria. Biopesticide – Trichoderma and Bt *Power Point Presentation on Nitrogen Fixation	6
IV	Application: Commercial production of Transgenic crops- Impact of transgenic plants in agriculture and Horticulture. Production of transgenic plants and applications	6
V	Bioethics: Bioethical issue on GM crops. Biosafety norms and controlled field trials and release of transgenics (GMO). Plant Variety Protection Act: TRIPS and WTO. Regulatory issues of biotechnology improved plants	6
Total		30
* Model Preparation and Power Point Presentation - related to the above topics are to be Considered for Internal Exam only.		

Text Book:

- ❖ Nirmala C.B, Rajalakshmi. G and Karthik. C (2009). Plant Biotechnology (1st ed.). MJP Publishers. ISBN-13: 978-8180940378
- ❖ Kumar HD. (2016). Agricultural Biotechnology, New Delhi. Daya Publishing house. ISBN 9788170354123
- ❖ Joshi Rajmohan. (2006). Agricultural Biotechnology, Isha Books. ISBN 10: 8182053803 ISBN 13: 9788182053809

Reference Book:

- ❖ Ahindra Nag. (2008). Text book of Agricultural Biotechnology, New Delhi. PHI Learning Private Limited. ISBN : 9788120335929
- ❖ Arie Altman, Rita Colwell. R. (2001). Agricultural Biotechnology, New York. Marcel Dekker. ISBN 13: 9780824794392.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	2	1	1	3	2	2	3	2	3	3	3	3	3	2
CLO2	3	2	1	1	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	2	1	1	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	2	1	1	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	2	1	1	3	3	3	2	3	2	3	3	3	3	3
Total	15	10	5	5	15	14	13	12	13	12	15	15	15	14	13
Average	3	2	1	1	3	2.8	2.6	2.4	2.6	2.4	3	3	3	2.8	2.6

Course Coordinator

BOS Chairman

SKILL ENHANCEMENT (FOUNDATION COURSE)
MUSHROOM CULTIVATION TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UBTF01	FOUNDATION COURSE	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ Students can start small scale industry of Mushroom cultivation- Students study the morphology and types of Mushrooms. They are aware of the identification of edible and poisonous Mushrooms
- ❖ Learned the prospects and scope of mushroom cultivation in small scale industry.
- ❖ Learned the life cycle of the *Agaricus species*
- ❖ Students will be able produce spawn on their own.
- ❖ Studied the technique of Mushroom cultivation. Understood the Diseases. Post harvesting techniques of Mushrooms.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To know the nutrient value of mushroom- To study the morphology and types of Mushrooms.	PO1
CO2	To learn the prospects and scope of mushroom cultivation in small scale industry.	PO1,PO2
CO3	To learn the life cycle of <i>Agaricus species</i>	PO4,PO6
CO4	To know the spawn production technique.	PO4,PO5,PO6
CO5	To understand the Diseases. Post harvesting techniques of Mushrooms.	PO3,PO8

Unit	Details	No. of Hours
I	Introduction: History and Scope of Mushroom Cultivation, Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms. *Poster Making: Mushroom Cultivation	6
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.	6
III	Lifecycle of <i>Pleurotus</i> spp and <i>Agaricus</i> spp.	6
IV	Sterilization of substrates, Spawn production, growth media, Mushroom bed Preparation, spawn running and harvesting. *Hands on Training: Mushroom Cultivation	6
V	Diseases and post-harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.	6
Total		30
* Poster Preparation and Hands On Training - related to the above topics are to be Considered for Internal Exam only.		

Text Books

- ❖ Hand book of Mushroom Cultivation. 2019. TNAU publication.
- ❖ Marimuthu, T., Krishnamoorthy, A. S., Sivaprakasam K. and Jayarajan. R. (2017). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

Reference Books

- ❖ Suman. 2005. Mushroom Cultivation Processing and Uses, M/s.IBD Publishers and Distributors, New Delhi.
- ❖ Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
- ❖ Hand book of Edible Mushroom Today and Tomorrows printers and publishers.
- ❖ Sharma V.P. 2006. Diseases and Pests of Mushrooms, M/s.IBD Publishers and Distributors, New Delhi.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CLO3	3	2	2	3	2	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	2	2	2	3	2	3	3	2	3	3	2	3	2
CLO5	3	2	3	3	3	3	3	2	3	2	3	2	3	3	3
Total	15	13	13	14	12	14	13	12	13	12	15	13	14	14	13
Average	3	2.6	2.6	2.8	2.4	2.8	2.6	2.4	2.6	2.4	3	2.6	2.8	2.8	2.6

SEMESTER-II

CORE PAPER III**GENETICS**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBT03	Core-III	Theory	Y	Y	-	5	5

Learning Objectives

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

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Obtain acquaintance on historical overview of microbial genetics and genetic Materials	PO1
CO2	Comprehend the concept of replication of genetic materials	PO1,PO2
CO3	Understand about regulation of gene expression and mutation	PO4,PO6
CO4	Grasp the Basic of genetics and their role	PO4,PO5,PO6
CO5	Gain knowledge on mutation	PO3,PO8

Unit	Details	No. of Hours
I	Basics of Genetics: History of Genetics - Mendelian Principles, Segregation, Independent Assortment, Dominance. Multiple alleles, Incomplete and complete dominance, Over dominance and co dominance. Chromosomal theory of inheritance, maternal effects. *Model Preparation- (Monohybrid and Dihybrid Cross)	15
II	Genetic Linkage and Mapping: Interaction of Genes- Epistasis and lethal genes. Linkage-linkage in Drosophila Morgan's experiments, factors affecting linkage. Crossing over-types and mechanism of crossing over. Sex determination and Sex linkage. Mapping of Chromosomes and Genes, interference and coincidence. Multiple alleles in Drosophila and Blood group inheritance in man.	15
III	Chromosomal Variation: Chromosomal aberrations- Numerical and Structural, Transposable elements in prokaryotes and eukaryotes. Structure of chromosome, fine structure of Gene, cistron, recon. *Poster Preparation on Chromosomal aberrations	15
IV	Gene Mutation : Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy).	15
V	Population Genetics: Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics and Euthenics.	15
Total		75
*Model Preparation and Poster Preparation- related to the above topics are to be Considered for Internal Exam only.		

Text Books

- ❖ Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11th Revised & Enlarged Edition, Kedar Nath Ram
- ❖ Verma, P.S. and Agarwal, V.K., 2005. Genetics, 8th edition, S. Chand & Co. New Delhi– 10055.

Reference Books

- ❖ Gardener E. J. Simmons M. J. Slustad D. P. 2006. Principles of Genetics.
- ❖ Lewis, R. 2001. Human Genetics - Concepts and application. 4th edition. Mc Graw Hill.
- ❖ Griffiths, Miller, J. H An Introduction to Genetic Analysis W. H. Freeman. New York.
- ❖ Winter, P. C., Hickey, G. J. and Fletcher, H. L. 2000. Instant notes in Genetics. Viva books, Ltd

Web Resources

- ❖ <https://nptel.ac.in/courses/102/106/102106025/>
- ❖ <http://www.ocw.mit.edu>
- ❖ <http://enjoy.m.wikipedia.org>
- ❖ <https://www.acpsd.net>

MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	2	3	2	3	2	3	3	2	2	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	2	2	2	3
CLO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	3	2	3	2	2	3	2	3	2	2	3	3	3	3
Total	15	14	14	15	13	14	13	12	13	12	14	13	13	14	13
Average	3	2.8	2.8	3	2.6	2.8	2.6	2.4	2.6	2.4	2,8	2.6	2.6	2.8	2.6

Course Coordinator

BOS Chairman

CORE PAPER - IV
HUMAN PHYSIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBT04	Core-IV	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ Illustrate about digestive secretions and absorptive mechanisms
- ❖ Comprehend the process of gaseous exchange in tissues and lungs
- ❖ Obtain an insight about muscle physiology and cardio vascular system
- ❖ Understand urine formation and physiology of reproductive system
- ❖ Get an idea about neuron structure and sensory physiology

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To build an in depth knowledge about basic physiological principles of various organs in the human body.	PO1
CO2	To understand physiology of various systems and its functions.	PO1,PO2
CO3	To get adequate knowledge on cardiovascular system and skeletal system	PO4,PO6
CO4	To understand physiology of excretory system	PO4,PO5,PO6
CO5	To get adequate knowledge on sensory organs.	PO3,PO8

Unit	Details	No. of Hours
I	Digestive System & Absorption : Overview of the digestive system, secretions of digestive tract, digestive hormones, process of digestion, absorption, assimilation of carbohydrates, proteins, fats, nucleic acids. Absorption of vitamins, minerals and water *Poster Preparation on Digestive System	6
II	Respiratory System : Overview of the respiratory system, pulmonary ventilation, Alveolar ventilation, composition and partial pressure of inspire air, alveolar air and expired air, exchange and transport of respiratory gases.	6
III	Muscle physiology and Cardiovascular System : overview of muscle tissue, contraction and relaxation of skeletal muscle, cardiac muscle tissue and cardiac conduction system, cardiac cycle, cardiac output. Circulatory System : Overview of Organs of Circulatory System *Power Point Presentation on Circulatory System	6
IV	Excretory System : Overview of renal system, Renal physiology: - glomerular filtration, tubular reabsorption and secretion, production of dilute and concentrated urine. Reproductive System : Overview of male and female reproductive system, menstrual cycle, physiology of pregnancy,(fetal development), fertilization process, parturition and lactation.	6
V	Nervous System : Overview of nervous system, classification of nervous system, signals transmission at synapse, neurotransmitters. Special Senses: Physiology of Olfaction, Gestation, Vision, Hearing and equilibrium.	6
Total		30
* Poster Preparation and Power Point Presentation - related to the above topics are to be Considered for Internal Exam only.		

Text Books

- ❖ Essentials of Medical Physiology, K. Sembulingam and Prema Sembulingam, 6th Edition, 2012
- ❖ Principles of Anatomy and Physiology, Tortora and Grabowski, 2003, John Wiley & Sons, Inc.
- ❖ Human Physiology, Chatterjee. C. 11th edition Medical agency allied, Calcutta..

Reference Books

- ❖ Textbook of medical physiology, A.C. Guyton 10th edition.
- ❖ Human body, Atlas, Publication Garden cheers.

❖ A Text Book of Human physiology, Sarada et al., 2010, S Chand & Company.

Web Resources

- ❖ <https://mymedicallibrary.files.wordpress.com/2016/08/jaypee-essentials-of-medical-physiology-6thedition.pdf>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	2	3	2	2	3	2	3	3	3	2	3	2
CLO2	3	2	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	2	3	3	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	2	3	3	3	3	3	2	3	2	3	3	2	3	3
Total	15	13	15	14	15	14	13	12	13	12	15	15	13	14	13
Average	3	2.6	3	2.8	3	2.8	2.6	2.4	2.6	2.4	3	3	2.6	2.8	2.6

Course Coordinator

BOS Chairman

ELECTIVE - II
FUNDAMENTALS OF MICROBIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTE02	ELECTIVE - II	Theory	Y	Y	-	3	3

Learning Objectives

- ❖ Understand the classification of Microorganisms and structure of bacteria
- ❖ Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.
- ❖ Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes.
- ❖ Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizers prebiotics and probiotics.
- ❖ Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Remember and recall the historical events which paved the development of different types of microscopes.	PO1
CO2	Understand and differentiate the different types of microbes	PO1,PO2
CO3	Analyze the media composition and grow the desired microbe	PO4,PO6
CO4	Apply the knowledge to enumerate the microorganisms from natural environment	PO4,PO5,PO6
CO5	Evaluate the success of understanding the microbial diseases	PO3,PO8

Unit	Details	No. of Hours
I	Basics of Microbiology: Definition of Microbiology– History and Scope of Microbiology– Contributions– Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming. Classification of microorganisms- Whittaker's five kingdom concept. *Model Preparation on Five Kingdom Concept	9
II	Microscopy and Staining: Types of microscopy – Definitions, light, dark field, phase contrast, fluorescence, and electron microscopes. Principles and types of stain–Simple stain, differential stain- Cell wall of Gram positive and Gram-negative bacteria and principle of Gram staining, Endospore & Capsular Staining. *Field Visit to Research Institution and Report Submission	9
III	Media preparation –Liquid media, Solid Media , Selective Media, enriched, enrichment and Differential Media; Isolation Of pure culture–Pour, Spread plate and Streak plate methods.	9
IV	Sterilization methods - physical and chemical methods. Definition and classification of antibiotics. Mode of action of different groups of antibiotics– Antimicrobial resistance and its mechanism. MRSA, ESBL	9
V	Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).	9
Total		45
*Model Preparation and Field Visit - related to the above topics are to be Considered for Internal Exam only.		

Text Books

- ❖ Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition. Mc Graw–Hill, New York.
- ❖ Dubey R.C and Maheswari, S. (2003). A txt book of Microbiology, New Delhi: S. Chand & Co.
- ❖ Ananthanarayanan, Paniker, Kapil, Text book book of Microbiology, 9th edition, Orient Black Swan, 2013.
- ❖ Prescott, Harley, Klein, Microbiology, 10th Edition, Mc Graw– Hill, 2016.
- ❖ Gerhardt, P., Murray, R.G ., Wood, W. A .and Kreig, N. R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.

Reference Books

- ❖ Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017.
- ❖ Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012.
- ❖ Boyd, R. F. (1998). General Microbiology, 2nd Edition., Times Mirror, Mos by College Publishing, St Louis.
- ❖ Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11th Edition., Ala Carte Pearson.
- ❖ Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw HillInc. New York.

Web Resources

- ❖ <http://www.ejb.org/content>.
- ❖ [www.Biotech.kth.se/ElectronicJournal of biotechnology](http://www.Biotech.kth.se/ElectronicJournal%20of%20biotechnology)
- ❖ <https://bio.libretexts.org/@go/page/9188>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	2	3	2	2	3	3	2	3	3	2	3	2
CLO5	3	3	2	3	3	3	3	2	3	2	3	2	3	3	3
Total	15	15	14	14	14	14	13	12	13	12	15	14	14	14	13
Average	3	3	2.8	2.8	2.8	2.8	2.6	2.4	2.6	2.4	3	2.8	2.8	2.8	2.6

Course Coordinator

BOS Chairman

CORE PRACTICAL - II
GENETICS AND MICROBIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTP02	CORE PRACTICAL II	Practical	-	-	Y	4	3

Learning Objectives

- ❖ Demonstrate the basic principles of important techniques in Molecular biology and Genetics. Analyze the Polytene chromosome of the organisms. Identify Barr bodies from Buccal smear
- ❖ Demonstrate the Preparations and maintenance of culture medium Demonstrate Human karyotyping
- ❖ Describe the general Laboratory safety & Sterilization Techniques
- ❖ Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques
- ❖ Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques. Perform the Motility of organisms.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Examine and evaluate the stages of Mitosis	PO1
CO2	Analyze the sex chromatin present in different cells	PO1,PO2
CO3	Be aware of the laboratory rules and regulations	PO4,PO6
CO4	Learns to visualize the cells by employing different types of microscopes	PO4,PO5,PO6
CO5	Bring in the concepts of microbial culturing techniques	PO3,PO8

Unit	Details	No. of Hours
I	1. Isolation of mutants by replica plating 2. Isolation of mutants by Gradient plate methods (Streptomycin) 3. Giant chromosomes from Chironomus larvae/ Drosophila salivary glands 4. Identification of Barr bodies from Buccal smear	15
II	5. Preparations of culture medium and culture of Drosophila – methods of maintenance 6. Identifications of mutants of Drosophila Human karyotyping (Demo)	15
III	7. Sterilization techniques 8. Media preparation–Liquid, Solid Media and Slant preparation 9. Isolation of bacteria from air, soil and water. Serial dilution method. 10. Pure Culture Techniques: i. Spread plate method. ii. Pour plate method. iii. Streak Plate Method (simple, continuous, T ⁺ streak and quadrant streak methods) iv. Settle plate procedure	10
IV	11. Staining techniques: Simple, Gram ⁺ s, Capsule Spores, 12. Preparation of temporary mounts- Lacto phenol cotton blue staining. 13. Motility test: Hanging drop technique.	10
V	14. Biochemical characterization - catalase, oxidase, IMVIC test and TSI. 15. Antibiotic sensitivity test by Kirby-Bauer method.	10
Total		60

Text Books

- ❖ Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi
- ❖ Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
- ❖ James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York 1996.
- ❖ Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
- ❖ Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
- ❖ R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.

Reference Books

- ❖ Atlas. R (1997). Principles of Microbiology, 2nd Edition, Wm. C. Brown publishers.
- ❖ Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
- ❖ Talib V H (2019). Hand book Medical Laboratory Technology. (2nd Edition). CBS.
- ❖ Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
- ❖ Lim D. (1998). Microbiology, 2nd Edition, WCB Mc Graw Hill Publications.

Web Resources

- ❖ <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.
- ❖ <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
- ❖ https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
- ❖ <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	2	3	2	2	3	3	2	3	3	2	3	2
CLO5	3	3	2	3	3	3	3	2	3	2	3	2	3	3	3
Total	15	15	14	14	14	14	13	12	13	12	15	14	14	14	13
Average	3	3	2.8	2.8	2.8	2.8	2.6	2.4	2.6	2.4	3	2.8	2.8	2.8	2.6

Course Coordinator

BOS Chairman

NON MAJOR ELECTIVE II
ORGANIC FARMING AND HEALTH MANAGEMENT

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTN04	NON MAJOR ELECTIVE II	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ The student will value the concepts of ecology and environment
- ❖ To know the techniques of Vermicomposting and enjoying the cultivation of common Medicinal Herbs
- ❖ To gain the knowledge about Principles and Policies in Organic farming and Certification agencies
- ❖ To realize the Concept of Health and importance of well being
- ❖ To appreciate the Role of exercise and nutrition in Health related fitness

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To understand advanced concepts of crop growth and productivity in relation to climate change	PO1
CO2	Students will have knowledge on the conservation of biodiversity	PO1,PO2
CO3	Understand the principles of agribusiness management.	PO4,PO6
CO4	Discuss and learn public health care system in India	PO4,PO5,PO6
CO5	Analyze the health conditions of the family members	PO3,PO8

Unit	Details	No. of Hours
I	Organic farming – definition – need – scope – principles – characteristics - relevance to modern agriculture. Different eco friendly farming systems- biological farming, natural farming, regenerative agriculture – permaculture - biodynamic farming. Ecology and Environment–Principles of ecology – Ecosystem- Biotic and abiotic components and interaction *Field Visit to TNAU and Report Submission	6
II	Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit – Nutrition garden –Ring garden–Double digging– Cultivating vegetables– Common medicinal herbs – Identification and Cultivation.	6
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. *Power Point Presentation on Organic farming	6
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.	6
V	Exercise and Health related fitness: Health related fitness, health promotion and physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.	6
Total		30
*Power Point Presentation and Field visit- related to the above topics are to be Considered for Internal Exam only.		

Text Books

- ❖ G.K.Veeresh, 2016. Organic farming, First edition, New Delhi, India Foundation Books in association with Centre for Environment Education.
- ❖ Mangalarai, 2012. Hand Book of Agriculture, Sixth Edition, ICAR New Delhi.
- ❖ B.B.Sharma, 2007. A Guide to Home Gardening, Second Edition, MIB India, New Delhi.
- ❖ Adrienne E. Hardman, 2009. Physical Activity and Health–The evidence explained, Second edition, Taylor and Francis Group.

Reference Books

- ❖ Farmers of Forty Centuries: Permanent Organic Farming in China, Korea, and Japan Hard cover – 10 June 2011 by F. H. King
- ❖ 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

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3
Total	15	15	15	15	15	15	13	12	13	12	15	15	15	14	13
Average	3	3	3	3	3	3	2.6	2.4	2.6	2.4	3	3	3	2.8	2.6

Course Coordinator

BOS Chairman

NON MAJOR ELECTIVE II

BIOTECHNOLOGY FOR SOCIETY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTN05	NON MAJOR ELECTIVE II	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation
- ❖ Will gain knowledge about the production of Bio fertilizer and advantages of Biopesticides
- ❖ Will understand the significance of microorganisms in Biodegradation
- ❖ Will get know about History of Antibiotics
- ❖ Will able to comprehend about Transgenic Plants

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To explain genome organization in Prokaryotes and Eukaryotes.	PO1
CO2	To describe Nucleic acids Replication, Recombination and its Repair Mechanisms.	PO3,PO4
CO3	To know how about the Interaction of Computer and Biology.	PO2,PO6
CO4	To understand the Knowledge about Protein and Genome Databases	PO5,PO7
CO5	To understand principles of animal culture, media preparation	PO8,PO9, PO10

Unit	Details	No. of Hours
I	Introduction to Biotechnology: Role of Biotechnology in sericulture-Rearing of silk worms- Importance and applications- Role of Biotechnology apiculture- Bee hive hierarchy- Bee keeping process- Products obtained-Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation. *Field Visit to Sericulture Institution and Report Submission	6
II	Biofertilizer - Definition- Mass production of <i>Rhizobium</i> - Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- <i>Bacillus huringiensis</i> - Single cell protein-Introduction-history production of <i>Spirulina</i> SCP- Applications- Advantages & disadvantages.	6
III	Biodegradation- Definition- Process-role of microorganisms in biodegradation- biodegradable plastics- advantages-Bioweapons- Introduction- history- potential agents-delivery methods- harmful effects. *Power Point Presentation on Biodegradation	6
IV	Antibiotics- Definition- Introduction and history of antibiotics-sources-classification- spectrum- production of penicillin-definition of antibiotic resistance.	6
V	Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr- Savrtomato and Golden rice-history– importance, applications, advantages and disadvantages.	6
Total		30
* Power Point Presentation and Field Visit - related to the above topics are to be Considered for Internal Exam Only.		

Text Books

- ❖ Sathyanarayana, U., Chakrapani, U., (2019). Biotechnology, 12th edition, Books and allied (P) Ltd, Kolkata.
- ❖ A.K. Chatterji, (2011). Introduction to Environmental Biotechnology, Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9
- ❖ R.C. Dubey, (2014). A text book of Biotechnology, S.Chand& Company, New Delhi. ISBN 9788121926089
- ❖ H. Patel, (2011).Industrial Microbiology, (2nd edition), MacMillan Publishers
- ❖ Thakur, I.S., (2019). Environmental Biotechnology- Basic principles and applications- (2nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9

Reference Books

- ❖ Basics of Biotechnology Paperback – 1 January 2004 by A. J. Nair (Author)
Publisher Laxmi Publications
- ❖ Basic Biotechnology Paperback – 2 February 2008 by Ratledge Colin (Author)
Publisher Cambridge University Press.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	2	3	3	2	3
CLO3	3	2	3	3	3	3	3	2	2	3	3	2	3	3	3
CLO4	3	3	3	3	3	3	2	3	3	2	3	3	3	3	2
CLO5	3	3	3	3	2	3	3	2	3	2	2	3	3	3	3
Total	15	14	15	15	14	15	13	12	13	12	13	14	15	14	13
Average	3	2.8	3	3	2.8	3	2.6	2.4	2.6	2.4	2.6	2.8	5	2.8	2.6

Course Coordinator

BOS Chairman

SKILL ENHANCEMENT COURSE
VERMICOMPOSTING TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTS01	SKILL ENHANCEMENT	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ Vermicomposting technology broadly followed at the global level and some Indigenous methods, role of microbes in increasing the soil fertility by the action of earthworms, their advantages and limitations dealt
- ❖ understand the environmental conservation process and its importance, pollution control, biodiversity and protection of earthworms through vermiculture
- ❖ To learn vermicomposting techniques
- ❖ Contribute their knowledge to develop organic fertilizer with rural and urban biodegradable wastes using the Earthworms.
- ❖ To understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Find out Vermicomposting is an eco-friendly, economically and socially acceptable technology	PO1
CO2	Illustrate that Vermitechnology is useful for stabilization and recycling of both industrial and domestic organic waste.	PO1,PO2
CO3	Utilize Vermitechnology to improve the soil texture, soil aeration, improve the water retention capacity in the soil	PO4,PO6
CO4	Improve Vermitechnology to manufacture the vermicompost in small scale industry by which the economy of the farmer is improved. It provides the employment opportunity in rural and urban areas.	PO4,PO5,PO6
CO5	Justify and prove that the Earthworms are having the capacity to observe heavy metals into their body tissues and converting the soil without heavy metals.	PO3,PO8

Unit	Details	No. of Hours
I	Introduction to vermiculture: Definition, meaning, history, economic importance, their value in maintenance of soil structure, role as four R's of Recycling - Reduce, Reuse, Recycle, Restore. Types, Collection and Preservation of earthworms. Complementary activities of auto evaluation. *Model Preparation on Earthworms	6
II	Culturing techniques of earthworms and composting materials: General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.	6
III	Small scale techniques of Vermicomposting - Indoor dual bin method; Bed method; Pit method; Heap method; Expand able worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost. * Hands on Training on Preparation of Vermicompost	6
IV	Large scale techniques of Vermicomposting Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter Vermicomposting; Keep it simple and save plan.	6
V	Vermi wash and Economics- Chemical composition of vermin wash; Techniques of vermin wash production: Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.	6
Total		30
* Model Preparation and Hands on Training - related to the above topics are to be Considered for Internal Exam Only.		

Text Books

- ❖ Vermiculture and Vermicompost (Earthworm), by Dr. Himadri Panda (Author), 2022, 3rd edition, Asia Pacific Business Press Inc.
- ❖ The Earthworm book, Ismail, S.A., other India Press, Goa
- ❖ Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
- ❖ Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.
- ❖ Ranganathan, L.S. 2006. Vermi biotechnology from soil health to human health—Agrobios, India.

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME
SPECIFIC OUTCOME**

	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	3	2	3	2	3	3	2	3	3	3	3	2
CLO5	3	2	3	2	3	3	3	2	3	2	3	2	3	3	3
Total	15	14	15	14	13	15	13	12	13	12	15	14	15	14	13
Average	3	2.8	3	2.8	2.6	3	2.6	2.4	2.6	2.4	3	2.8	3	2.8	2.6

Course Coordinator

BOS Chairman

SKILL ENHANCEMENT COURSE

SEED TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UBTS02	SKILL ENHANCEMENT	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To introduce the concepts of experimental design in Seed Technology
- ❖ To inculcate sense of job responsibilities, while maintaining social and environment awareness
- ❖ To help students build-up a progressive and successful career in industries with a biotechnological perspective
- ❖ To understand the seed viability and introduce the concept in the field
- ❖ To create an idea about seed technology in the agricultural field

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	To supply high quality seeds, means seeds of high yielding varieties, varieties with resistance to diseases and pests	PO1
CO2	To increase agricultural production by supply of quality seed.	PO1,PO2
CO3	To assure rapid seed multiplication of desirable varieties.	PO4,PO6
CO4	To check the viability of the seeds	PO4,PO5,PO6
CO5	To Enhance Seed Conservation	PO3,PO8

Unit	Details	No. of Hours
I	Seed Morphology: Dicot and Monocot Seeds. Morphology and Types. Seed Reserves. Internal and External structures:- their functional significance. Albuminous and ex-albuminous seeds. Large and small seeds *Model Preparation - (Dicot and Monocot Seeds)	6
II	Seed Dormancy: Seed Dormancy: Types of dormancy - physical, physiological, morphological, chemical and mechanical. Primary and secondary dormancy. Skoto and photo dormancy. Methods to overcome dormancy. Ecological significance of seed dormancy	6
III	Seed Germination: Seed Germination: Epigeal and hypogeal germination. Germination mechanism. Brief account of Germination value (Czabator), Germination rate (Bartellete). Total germination percent and plant percent. Germination ecology: Environmental factors and germination behaviour *Poster Preparation on Seed Germination	6
IV	Seed Viability: Seed Viability: Viability tests-their significance and importance. Orthodox and recalcitrant seeds. Critical role of seed moisture content and environmental factors on viability. Viability periods of selected Indian Forestry species	6
V	Seed Storage and Longevity: Seed Storage and Longevity: Seed germplasm and storage in different conditions. Cryopreservation. Static conservation of seeds. Clonal seed orchards. Seed certification; seed banks	6
Total		30
* Model Preparation and Poster Preparation - related to the above topics are to be Considered for Internal Exam Only.		

Text Book

- ❖ Principles of seed production by K. Vanangamudi (2003 Seed technology by R L Agarawal.

Reference Book:

- ❖ Principles of seed production by M. Baskaran, A. Bharathi, K. Vanangamudi, Natrajan, P. Nadesan. (2003).
- ❖ Advance course post harvest handling and management of seed by J. P Sinha and S. M. Sinha (2000).

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME
SPECIFIC OUTCOME**

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CLO3	3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CLO4	3	3	3	3	2	3	2	3	3	2	3	3	3	3	2
CLO5	3	2	3	2	3	3	3	2	3	2	3	2	3	3	3
Total	15	14	15	14	13	15	13	12	13	12	15	14	15	14	13
Average	3	2.8	3	2.8	2.6	3	2.6	2.4	2.6	2.4	3	2.8	3	2.8	2.6

Course Coordinator

BOS Chairman

SEMESTER – III

SECOND YEAR – SEMESTER - III
CORE PAPER V- IMMUNE SYSTEM AND IMMUNO TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBT05	Core-V	Theory	Y	Y	-	4	5

Learning Objectives

- ❖ Explain the role of immune cells and their mechanism in body defense mechanism
- ❖ Demonstrate the antigen –antibody reactions in various immune techniques
- ❖ Gain new insights into Antigen -Antibody interactions and to demonstrate immunological techniques.
- ❖ Gain knowledge of production of vaccines.
- ❖ Apply the knowledge of immune associated disease, hypersensitivity reactions.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Design a model of Immunoglobulin/Antibodies	PO1,PO5,PO6,PO8,PO10
CO2	Describe which cell types and organs present in the immune response	PO1,PO5,PO6,PO8
CO3	Illustrate various mechanisms that regulate immune responses and maintain Tolerance	PO9,PO5
CO4	Exemplify the adverse effect of immune system including Allergy,	PO7,PO8
CO5	Gain knowledge on hypersensitivity and autoimmunity	PO6,PO10

Unit	Details	No. of Hours
1	Introduction to Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Haematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired.	12
2	Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology and Applications. Antigen processing and presentation (MHC molecules – structure, types and functions).	12
3	Antigen – Antibody interactions- Agglutination and precipitation reactions, Immunodiffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Fluorescent antibody technique and Western Blotting. Purification of antibodies.	12
4	The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Cytokines- Structure, types and biological functions. Vaccines – Types, Production and application.	12
5	Hypersensitivity Reactions and Types. Major Histocompatibility Complex – MHC genes, Structure and function of Class I and Class II MHC molecules. HLA tissue typing. Auto immunity and autoimmune disorders. Transplantation immunology, Graft vs Host reaction mechanism of graft rejection.	12
Total		60

Text Books

- ❖ Thomas J. Kindt, Barbara A. Osborne and Richard A Goldsby, 2006. Kuby Immunology. 6th edition, W. H. Freeman and Company.
- ❖ Kannan, I., 2010. Immunology. MJP Publishers, Chennai
- ❖ Abbas, A.K., A.H.L., Lichtman and S. Pillai, 2010. Cellular and Molecular Immunology, 6th Edition. Saunders Elsevier Publications, Philadelphia
- ❖ NandiniShetty, 1996, Immunology: introductory textbook – I. New Age International, New Delhi.
- ❖ Fahim Halim K., 2009. The Elements of Immunology. Pearson Education.

Reference Books

- ❖ Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt's Essential Immunology, 12th edition, Wiley- Blackwell. USA.
- ❖ Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition
- ❖ William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rd Edition. John Wiley and Sons Inc. New York
- ❖ Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4th Edition., WileyBlackwell.
- ❖ Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM. 3rd Edition

Web Resources

- ❖ <https://www.ncbi.nlm.nih.gov/books/NBK279395/>
- ❖ <https://med.stanford.edu/immunol/phd-program/ebook.html>
- ❖ <https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology/fall2005/pages/lecture-notes/>
- ❖ Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
- ❖ Immunology - an overview | Science Direct Topics

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	3	3	3	2	3	2	3	3	2	2	1	1
CO2	3	2	3	2	3	3	2	3	2	2	2	3	2	2	1
CO3	3	2	3	3	3	3	2	3	3	2	2	3	3	2	2
CO4	3	2	3	3	3	2	2	3	3	2	1	2	1	3	2
CO5	3	2	3	3	3	3	2	3	3	2	1	2	1	2	3
Total	15	10	14	14	15	14	10	15	13	11	9	10	12	9	9
Average	3.0	2.0	2.8	2.8	3.0	2.8	2.0	3.0	2.6	2.2	1.8	2.0	2.4	1.8	1.8

Course Coordinator

BOS Chairman

CORE PAPER VI- CLINICAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBT06	Core-VI	Theory	Y	Y	-	3	2

Learning Objectives

- ❖ The major objective of the paper is to envisage thorough knowledge in genetic diseases
- ❖ Offers knowledge regarding Chromosomal aberrations
- ❖ Provides knowledge on genetic diseases
- ❖ Provides knowledge regarding various aspects of Human genetics
- ❖ Provide knowledge regarding clinical management and clinical enzymes

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	The students will gain knowledge about the inheritance pattern of the genes and genetic diseases	PO1,PO2
CO2	Gain knowledge on numerical and structural changes of chromosomal	PO5,PO3
CO3	The students will learn the modern molecular techniques for genetic disease diagnosis	PO4,PO6
CO4	The students learn about the inheritance pattern of genes which cause genetic diseases in humans	PO7,PO8
CO5	Gain knowledge on clinical management and clinical enzymes	PO9,PO10

Unit	Details	No. of Hours
1	Classification of genetic diseases. Chromosomal disorders-numerical disorders e.g. trisomers and monosomes, structural disorders e.g. deletions, duplications, translocations and inversions, chromosomal instability syndromes.	9
2	Gene controlled diseases-autosomal and X-linked disorder, mitochondrial disorders, Fragile X syndrome, and myotonic dystrophy. Mitochondrial diseases. Microarray technology application in diseases.	9
3	Huntington's disease- sickle cell diseases, AAT (alpha-1 antitrypsin deficiency), Alzheimer's disease, cystic fibrosis, infection of nervous system.	9
4	Clinical management & metabolic manipulation – PKU, Familial hyper cholesterolemia, Rickets, ADA, Congenital hypothyroidism.	9
5	Clinical Enzymes: Enzymes as thrombolytic agents, anti inflammatory agents, Streptokinase & Asparaginase. Catalytic antibodies.	9
Total		45

Text Books

- ❖ Ricki Lewis, 2019. Human Genetics: Concepts and Applications, 12th Edition, McGraw Hill Education.
- ❖ Robert H. Tamarin, 2016. Principles of Genetics, Tata McGraw Hill Publishing Company Ltd.
- ❖ Roxann Schroeder, 2020. Human Genetics: Understanding How Genes Work, Great River Learning.
- ❖ D. Peter Snustad and M.J. Simmons, 2017. Principles of Genetics, 7th Edition, Wiley India Pvt. Ltd.
- ❖ Strachan T. and Read A., 2018. Human Molecular Genetics, 5th Edition, Garland Science.

Reference book

- ❖ Betty Forbes, Danial SAHM Alics Weinfield, Bailey 2007. Scott's diagnostic microbiology, 12th edition Mosby.
- ❖ Gerald collee, J, Andrew G. Fraser, Barri P Marmion, Mackie and Mc Cartney's Pratical medical microbiology, elesiver 2006.
- ❖ Elmer W Koneman et al., Koneman's 2005. Color Atlas and Textbook of diagnostic microbiology, 6th edition. Lippincott Williams and Wilkins 35

Web Resources

- ❖ [OMIM – Online Mendelian Inheritance in Man](#)
- ❖ GeneReviews – NCBI Bookshelf
- ❖ [Genetic and Rare Diseases Information Center \(GARD\)](#)
- ❖ Learn Genetics – University of Utah
- ❖ [Genome.gov – Chromosome Abnormalities Fact Sheet](#)
- ❖ DECIPHER Database

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	3	3	3	2	3	2	3	3	2	2	1	1
CO2	3	2	3	2	3	3	2	3	2	2	2	2	3	2	1
CO3	3	2	3	3	3	3	2	3	3	2	3	3	2	2	2
CO4	3	2	3	3	3	2	2	3	3	2	2	3	2	2	1
CO5	3	2	3	3	3	3	2	3	3	2	1	2	1	2	3
Total	15	10	14	14	15	14	10	15	13	11	11	12	10	9	8
Average	3.0	2	2.8	2.8	3.0	2.8	2.0	3	2.6	2.2	2.2	2.4	2.0	1.8	1.6

Course Coordinator

BOS Chairman

ELECTIVE III BIOINFORMATICS AND BIOSTATISTICS

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTE03	Ele-III	Theory	Y	Y	-	3	3

Learning Objective

- ❖ Acquire knowledge about the Developments and Applications of Bioinformatics
- ❖ Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.
- ❖ Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.
- ❖ Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency
- ❖ Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	A student will develop a fundamental knowledge of DNA databank , protein data bank and sequence alignment tool	PO1,PO2
CO2	Acquire knowledge on handling biological databases	PO3,PO4
CO3	Understand the practical skills in Statistics	PO7,PO6
CO4	Understand test of significance	PO5,PO8
CO5	Understand measures of central tendency like mean median-mode	PO9,PO10

Unit	Details	No. of Hours
1	Introduction to Bioinformatics – Genome, Transcriptome and Proteome, Gene prediction rules and software. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – CATH, SCOP – Data base Searching – BLAST and FASTA, BLOSSUM	9
2	Sequence analysis (Proteins and Nucleic acids), Protein Database: Comparison of Protein sequences and Database searching – methods for protein structure prediction - Homology modelling of proteins, visualization tools (RASMOL).	9
3	Multiple Sequences alignment – method - Evolutionary analysis, clustering methods. Phylogenic trees - Methods to generate phylogenetic tree - Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.	9
4	Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency – measures of dispersion.	9
5	Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance –t tests – F tests – Chi square test.	9
Total		45

Text Books

- ❖ Pennington, S.R. and Pun, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pvt. Ltd
- ❖ Shuba G., 2010. Bioinformatics. Tata McGraw Hill publishing. India.
- ❖ Rastogi, S.C, Mendiratta, N, Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.
- ❖ N.Gurumani (2011) "An Introduction to Biostatistics" MJP Publishers.

- ❖ VerbalRastogi .(2011).”Fundamentals of Biostatistics”, Ane books Pvt Ltd Publishers, Chennai.

Reference Books

- ❖ Attwood, T.K. and Parry-Smith, D.J.2008. Introduction to Bioinformatics. Pearson Education.
- ❖ David Mount., Bioinformatics: sequence and genome analysis, second edition. Taylor & Francis, UK; 2009.
- ❖ D.R.Westhead. Instant Notes in Bioinformatics. Second edition. Taylor & Francis, UK; 2009.
- ❖ Zar,(J.H.2010).”Biostatistical Analysis” Fifth Edition, Pearson Education Pvt Ltd, Indian Branch, New Delhi.
- ❖ P.N.Arora and P.K. Malhan.(2013)"Biostatistics” Himalaya publishing House.

Web Resources

- ❖ NCBI – National Center for Biotechnology Information – GenBank, Protein, Structure databases, BLAST, FASTA.
- ❖ [ExPASy – SIB Bioinformatics Resource Portal](#) – Genome, transcriptome, proteome databases; structure and sequence analysis tools.
- ❖ UniProt Knowledgebase – Protein sequences, function, and annotation.
- ❖ RCSB Protein Data Bank (PDB) – 3D macromolecular structures and visualization (RASMOL, PyMOL).
- ❖ [StatTrek](#) – Tutorials and calculators for statistics, probability distributions, and hypothesis testing.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	3	2	2	3	2	3	2	2	3	2	2	1	1
CO2	3	2	3	2	2	3	2	3	2	2	3	2	2	1	1
CO3	2	2	3	3	3	3	2	3	3	2	2	2	3	3	2
CO4	2	2	3	3	3	3	2	3	3	2	1	2	2	3	2
CO5	2	2	3	3	3	3	2	3	3	2	1	2	1	2	3
Total	12	10	15	13	13	15	10	15	13	10	10	10	10	10	9
Average	2.4	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2	2	2	2	1.8

Course Coordinator

BOS Chairman

CORE PRACTICAL III – IMMUNOTECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTP03	Core Practical-III	Practical	-	-	Y	4	3

Learning Objective

- ❖ Perform blood grouping and determine blood type. Able to count WBC and RBC.
- ❖ Conduct serological diagnostic tests such as ASO, CRP, RA and Widal test.
- ❖ Acquire technical skills required for immunodiffusion and know the principle behind the techniques. Able to Demonstrate ELISA, Handling of Laboratory animals.
- ❖ Analyse the Biological databases, Able to perform BLAST and FASTA
- ❖ Represent data in to graphical form, Test the level of significance of biological data and interpret the results. Determine averages of the biological data.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the practical skills in Immunology	PO1,PO2
CO2	Examining and analyzing the results involved in immune techniques	PO5,PO3
CO3	Acquire skills in instrument handling	PO4,PO6
CO4	To know about the biological databases	PO7,PO8
CO5	Learn about MS excel, Data Analysis and Interpretation	PO9,PO10

Unit	Details	No. of Hours
1	IMMUNOTECHNOLOGY 1. Separation of Serum and Plasma. 2. Blood grouping and Rh typing. 3. WBC counting 4. RBC counting	12
2	5. Differential blood count 6. WIDAL Slide test 7. ASO test	12
3	8. Immuno electrophoresis 9. Double Immunodiffusion 10. Single Radial Immunodifusion	12
4	11. Biological databases (NCBI, SWISSPROT and PDB) 12. Sequence retrieval and alignment 13. BLAST FASTA 14. Protein visualization tools (Rasmol)	12
5	15. Preparation of bar diagram, line diagram and pie diagram using MS EXCEL. 16. Measurement of Central tendency- mean, geometric mean, median using MS EXCEL 17. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL.	12
Total		60

Text Books

- ❖ Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
- ❖ Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.

Reference Books

- ❖ Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
- ❖ Rose. (1992). Manual of Clinical Lab Immunology, ASM.
- ❖ Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
- ❖ Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.

- ❖ Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition. Wiley-Blackwell.

Web Resources

- ❖ https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
- ❖ <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf>
- ❖ https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
- ❖ Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	3	2	2	3	2	3	2	2	3	2	2	1	1
CO2	3	2	3	2	2	3	2	3	2	2	2	3	3	2	1
CO3	2	2	3	2	2	3	2	3	2	2	3	2	3	1	1
CO4	3	2	3	2	2	3	2	3	2	2	2	2	2	3	2
CO5	2	2	3	3	3	3	2	3	3	2	1	2	1	2	3
Total	13	10	15	11	11	15	10	15	11	10	11	11	11	9	8
Average	2.6	2	3	2.2	2.2	3	2	3	2.2	2	2.2	2.2	2.2	1.8	1.6

Course Coordinator

BOS Chairman

Skill Enhancement Course - II

DNA TYPING IN FORENSIC

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTS03	SEC-II	Theory	Y	Y	-	1	1

Learning Objective

- ❖ Basic knowledge in DNA structure
- ❖ To understanding of the various uses of DNA typing technology

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the basic principle of DNA analysis	PO1,PO3
CO2	Analyze the forensic significance of DNA typing.	PO2,PO4
CO3	Evaluating the role of DNA typing in parentage testing.	PO5
CO4	Understand the importance of Short Tandem Repeats and Restriction Fragment Length Polymorphism in DNA technique	PO8,PO10
CO5	Understand the basic principle of DNA analysis	PO6,PO7

Unit	Details	No. of Hours
1	DNA as biological blueprint of life - Extraction of DNA for analysis - Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis	6
2	Collection of specimens. Polymerase chain reaction. Short tandem repeats (STR). Restriction fragment length polymorphism (RFLP).	6
3	Principles of heredity .Genetics of paternity. DNA testing in disputed paternity. Mendelian laws of parentage testing. Mathematical basis of parentage identification.	6
4	Allele frequency determination. Hardy-Weinberg law. DNA Extraction-Basic Principles -Method of DNA extraction. DNA Quantification - Southern Blotting.	6
5	Polymorphism in DNA system – DNA markers RELP, RAPD, VNTRs, SNP. Touch DNA.	6
Total		30

Text Books

- ❖ J.M. Butler, Forensic DNA Typing, Elsevier, Burlington (2005).
- ❖ K. Inman and N. Rudin, An Introduction to Forensic DNA Analysis, CRC Press, Boca Raton (1997).

REFERENCE BOOKS

- ❖ H. Coleman and E. Swenson, DNA in the Courtroom: A Trial Watcher's Guide, Gene Lex Corporation, Washington (1994).
- ❖ W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013)

Web sources

- ❖ “DNA Extraction and Quantitation for Forensic Analysts” — covers quantitation and slot-blot methods National Institute of Justice
- ❖ “The Extraction, Purification and Quantitation of DNA” (PDF) — description of slot/dot blot, quantitation, etc. archive.gfjc.fiu.edu
- ❖ “Is the Novel Slot Blot a Useful Method for Quantification ...” — more on slot blot method, advances PMC
- ❖ “Quantitation of DNA | PPTX” — overview of absorption spectrophotometry, yield gel method, slot blot technique www.slideshare.net

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	3	1	3	1	3	3	2	2	3	2
CO2	3	3	3	3	2	3	1	3	1	3	3	3	3	3	3
CO3	3	2	3	2	2	3	1	3	2	3	3	3	3	3	3
CO4	3	2	2	2	2	3	1	3	2	3	3	2	2	3	2
CO5	3	2	2	2	2	3	1	3	1	3	3	2	2	3	2
Total	15	11	12	11	10	15	5	15	7	15	15	12	12	15	12
Average	3.0	2.2	2.4	2.2	2.0	3.0	1.0	3.0	1.4	3.0	3.0	2.4	2.4	3.0	2.4

Course Coordinator

BOS Chairman

Skill Enhancement Course - II
QUALITY CONTROL IN INDUSTRIES

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTS04	SEC-II	Theory	Y	Y	-	1	1

Learning Objective

- ❖ To impart basic knowledge about quality control in pharmaceutical industry, quality control audits in industries.
- ❖ Train the students on the basics of food safety and food quality.
- ❖ To teach the microbial quality control in hospitals aim to impart knowledge on manufacturing operation in industries
- ❖ Acquire skills to Manufacturing operations and controls
- ❖ Demonstrate handling of waste and scrap disposal.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To acquire the knowledge quality control in pharmaceutical industry	PO1
CO2	To learn the quality control audits in industries.	PO1,PO2
CO3	To understand the basics of food safety and food quality.	PO3,PO5
CO4	Skilled on manufacturing operation in industries	PO4,PO6
CO5	To understand the manufacturing skills and controls	PO7,PO8

Unit	Details	No. of Hours
1	Industrial quality control-Process of quality control- sterile and non-sterile preparations – raw materials, purity check, quality check of finished products - Pharmaceutical products and their quality control-drugs and vaccines. Environmental Monitoring – Pharmaceutical industry.	3
2	Food safety and Food Quality-Microbiological criteria of food, food products, Monitoring of factory hygiene and sanitation, Food Safety and Standards. Food contaminants and diseases.	3
3	Microbial quality control in Hospitals-Control of Healthcare associated infections - Monitoring water quality in hospitals, healthcare infrastructures.	3
4	Manufacturing operations and controls-Sanitation of manufacturing premises, cross contamination, processing of bulk products, packaging operations, release of finished product.	3
5	Manufacturing operations and controls- Expiry date calculation, calculation of yields, production record review, and handling of waste and scrap disposal.	3
Total		15

Text Books

- ❖ Nally, J. D. (Ed.) (2007). Good Manufacturing Practices for Pharmaceuticals, Sixth Edition, Informa Healthcare USA, Inc., ISBN 10: 0-8593-3972-3 & ISBN 13: 978-0-8493-3972-1, New York.
- ❖ The training manual for Food Safety Regulators. (2011) Food Safety regulations and food safety management. Food Safety and Standards Authority of India, New Delhi (<http://www.fssai.gov.in/trainingmanual.aspx>)

Reference book

- ❖ U.S. Environmental Protection Agency (EPA). Washington, DC (2014). 21-Food and drugs, chapter I--Food and Drug Administration.
- ❖ WHOTRS823. (1992). WHO expert committee on specifications for pharmaceutical preparations: thirty-second report. WHO Technical Report Series: 823, ISBN 92 4140823 6, ISSN 0512-3054, Geneva

Web Sources

- ❖ <https://foodlicensing.fssai.gov.in/index.aspx>
- ❖ <https://www.fda.gov/drugs/pharmaceutical-quality-resources/guidances-and-manuals-pharmaceutical-quality>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	3	3	3	3	2	3	2	2	3	3	3	3	2
CO2	3	3	3	2	3	2	2	3	2	2	2	3	2	3	2
CO3	3	2	2	2	3	2	2	3	2	2	3	2	2	2	2
CO4	3	2	3	3	3	2	3	3	2	2	3	2	3	3	2
CO5	3	2	2	3	3	2	3	3	2	2	3	2	3	3	2
Total	15	11	13	13	15	11	12	15	10	10	14	12	13	14	10
Average	3.0	2.2	2.6	2.6	3.0	2.2	2.4	3.0	2.0	2.0	2.8	2.4	2.6	2.8	2.0

Course Coordinator

BOS Chairman

Skill Enhancement Course – II**SERI CULTURE**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTS05	SEC-II	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To know about the Mulberry and Non – mulberry silkworm types
- ❖ To understand the mulberry cultivation and silkworm rearing
- ❖ To acquire knowledge about silk reeling
- ❖ To know about the diseases of silkworm.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To identify the types of silk worms, and understand the basic aspects of culture	PO1,PO5
CO2	To assess and integrate the available tools and techniques to increase the productivity in culture areas.	PO2,PO4
CO3	To analyze the pros and cons of different methods of culture methods and marketing strategies of products.	PO3, PO5
CO4	To evaluate the use of available resources in improving the sericulture breeds, harvesting methods.	PO8
CO5	To design new methods to improve and increased the productivity and disease resistance and to construct new methods in sericulture	PO6,PO7

Unit	Details	No. of Hours
1	Types of silk worms – Tasar, Muga, and Eri. Morphology and life cycle of silk worm (<i>Bombyx mori</i>).	6
2	Mulberry cultivation in India - Selection of land and cultivation of mulberry – Mulberry varieties Different methods of planting – Organic and inorganic manure application.	6
3	Disinfection of rearing houses and appliances - Egg transportation and incubation – Egg handling – Hatching –Brushing –Silk worm rearing techniques.	6
4	Pest and diseases of silk worm and preventive measures. Harvesting of cocoon and quality assessment.	6
5	Reeling methods – Reeling and Re-reeling –Silk examination, cleaning, lacing, bookmaking and grading of silk. Field visit to silk worm rearing centre and reeling industry.	6
Total		30

Text Books:

- ❖ Ganga G., Sulochanachetty. J. An Introduction of Sericulture. Oxford, New Delhi – 1977.
- ❖ Johnson M., and Kesary M., Sericulture, CSI Press, Marthandam, 2008.
- ❖ Text Book of Tropical Sericulture, Pub., Japan Overseas Volunteers, 1975.
- ❖ Ullal S.R., and Narasimhan M.N., Hand Book of Practical Sericulture, CSB, Bangalore, 1987.

Reference Books:

- ❖ "Sericulture: Principles and Practices" by Dr. H.B. Mahesha Comprehensive coverage of silkworm biology, rearing techniques, and silk production.
- ❖ "Textbook of Sericulture" by Dr. S. Rajendran Detailed insights into mulberry cultivation, silkworm rearing, and silk processing.
- ❖ "Silk Reeling and Testing Manual" by FAO Technical manual focusing on cocoon characteristics, reeling methods, and silk testing.

Web Sources

- ❖ Agriculture Institute – Non-Mulberry Silkworms: Muga, Eri, and Tasar
<https://agriculture.institute/silkworm-rearing/non-mulberry-silkworms-muga-eri-tasar/>
- ❖ FAO – Silk Reeling and Testing Manual
<http://www.fao.org/4/x2099e/x2099e00.htm>
- ❖ Agriculture Institute – Silkworm Rearing Techniques
<https://agriculture.institute/silkworm-rearing/>

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC
OUTCOME**

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	2	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	2	3	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	11	14	14	13	14	11	15	14	11	15	14	14	14	14
Average	3.0	2.2	2.8	2.8	2.6	2.8	2.2	3.0	2.8	2.2	3.0	2.8	2.8	2.8	2.8

Course Coordinator

BOS Chairman

Skill Enhancement Course – II**MEDICINAL HERBS**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S3UBTS06	SEC-II	Theory	Y	Y	-	2	2

Learning Objective

- ❖ 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

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	demonstrate the ability to acquire basic knowledge on ethnobotany	PO1,PO3
CO2	To understand the role of herbal medicine	PO2,PO5
CO3	To know the diagnosis and treatment of diseases by tribal medicine	PO4,PO9
CO4	To understand the knowledge and utility of some medicinal plants	PO8,PO10
CO5	To understand the role of traditional medicine	PO6,PO7

Unit	Details	No. of Hours
1	Ethno medicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.	6
2	Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).	6
3	Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion – <i>Aegle marmelos</i> , <i>Ficus benghalensis</i> , <i>Curcuma domestica</i> , <i>Cynodon dactylon</i> and <i>Sesamum indicum</i> .	6
4	Traditional knowledge and utility of some medicinal plants in Tamil Nadu <i>Solanum trilobatum</i> , <i>Cardiospermum halicacabum</i> , <i>Vitex negundo</i> , <i>Adathoda vasica</i> , <i>Azadirachta indica</i> , <i>Gloriosa superba</i> , <i>Eclipta alba</i> , <i>Aristolochia indica</i> and <i>Phyllanthus fraternus</i> .	6
5	Plants in day today life – <i>Ocimum sanctum</i> , <i>Centella asiatica</i> , <i>Cassia auriculata</i> , <i>Aloevera</i> . Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and Vegetables - Greens (Moringa, <i>Solanum nigrum</i> Cabbage).	6
Total		30

Text Books

- ❖ R.K.Sinha & Shweta Sinha (2001), Ethnobiology. Surabhe Publications – Jaipur.
- ❖ D.C. Pal & S.K. Jain NayaPrakash, (1998), Tribal medicine, Bidhan Sarani, Calcutta ,
- ❖ S.K. Jain (2001) Contribution to Indian Ethnobotany – S.K. Jain, 3rd edition, scientific publishers, B.No.91, Jodhpur, India.
- ❖ Andrew Chevallie, (2000) Encyclopedia of Herbal Medicine

Reference Books

- ❖ Steven Horne and Thomas Easley (2016), Modern Herbal Dispensatory: A Medicine Making Guide
- ❖ M.C. Joshi (2007) Handbook of Indian Medicinal Plants Hardcover.
- ❖ Neelesh Malviya and Sapna Malviya (2019). *Herbal Drug Technology*, (1st Edition), CBS Publishers and Distributors, ISBN: 9789387964334.

- ❖ Rageeb Md. Usman, Vaibhav M. Darvhekar, Vijay Kumar D, and Akhila S.A, (2019). *Practical Book of Herbal Drug Technology*, (1st Edition), Nirali Prakashan Publishers, ISBN: 9789388108002.

Web Source

- ❖ Study.com. *Ethnomedicine: History and Examples*.
<https://study.com/learn/lesson/ethnomedicine-history-and-examples.html>
- ❖ PMC. *The Role and Place of Medicinal Plants in Disease Prevention and Control*.
<https://pmc.ncbi.nlm.nih.gov/articles/PMC3847409/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	2	2	3	3	2	3	2	2	2	2
CO2	3	2	3	2	2	3	2	3	3	2	3	3	3	2	3
CO3	3	2	3	2	2	3	2	3	3	2	3	3	3	3	3
CO4	3	2	2	2	3	2	2	3	3	2	3	2	2	2	3
CO5	3	2	3	2	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	13	10	12	13	10	15	15	10	15	13	13	12	14
Average	3.0	2.0	2.6	2.0	2.4	2.6	2.0	3.0	3.0	2.0	3.0	2.6	2.6	2.4	2.8

Course Coordinator

BOS Chairman

SEMESTER - IV

SECOND YEAR – SEMESTER - IV**CORE PAPER VII- GENETIC ENGINEERING**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBT07	Core-V	Theory	Y	Y	-	6	6

Learning Objective

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

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Acquaint with the vocabulary involved in molecular cloning strategies and techniques used to probe DNA for specific genes of interest	PO1,PO3
CO2	Apprehend with the tools and techniques in rDNA technology and types of Vectors	PO2,PO4
CO3	Relate the role of restriction and modifying enzymes in recombinant DNA Technology	PO5
CO4	Explore the techniques involved in construction of genomic DNA library and cDNA library	PO8
CO5	Design the protocols for analyzing gene transfer methods and to explore knowledge on hybridization based markers	PO6,PO7

Unit	Details	No. of Hours
1	Genetic Engineering – Introduction. Enzymes-Restriction enzymes, modifying enzymes, ligation. Vectors-Cloning vectors: plasmid - definition, properties and types. pUC19 & pBR322- phage vectors (λ & M13), Expression vectors; YAC (<i>S.cerevisiae</i> as a model) & BAC (<i>E.coli</i> host) – introduction of rDNA into host cells.	18
2	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 (RT PCR).	18
3	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.	18
4	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) and Random Amplified Polymorphic DNA (RAPD).	18
5	Application of Recombinant DNA technology in medicine, industry, agriculture and r-DNA technology - merits and demerits.	18
Total		90

Text Books

- ❖ Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.
- ❖ Desmond S.T. Nicholl, 2008. An Introduction to Genetic Engineering, 3rd edition, Cambridge university press.
- ❖ R.W. Old & S.B. Primrose, Principles of Gene Manipulation, Fifth Edition, Blackwell Science.
- ❖ Genetic Engineering Principles and Methods by Setlow, Jane K. (Volume 24).
- ❖ Keya Chaudhuri, 2012. Recombinant DNA Technology.

Reference Books

- ❖ David Clark Nanette Pazdernik Michelle McGehee (2018), *Molecular Biology techniques*, (3rd edition).
- ❖ Anton Byron (2019), *Introduction to Gene Cloning*, Publisher: Oxford Book Company
- ❖ Monika Jain (2012), *Recombinant DNA technology*, (I edition), Alpha Science International. ISBN-13 : 978-1842656679.
- ❖ Primrose.S.B (2014), *Principles of gene manipulation*, (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3

Web Resource

- ❖ <https://www.britannica.com/recombinant-DNA-technology>
- ❖ <https://www.le.ac.uk/recombinant-dna-and-genetic-techniques>
- ❖ <https://www.ncbi.nlm.nih.gov>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	3	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2
CO3	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	14	14	13	15	10	15	13	10	15	14	14	14	13
Average	3.0	2.0	2.8	2.8	2.6	3.0	2.0	3.0	2.6	2.0	3.0	2.8	2.8	2.8	2.6

Course Coordinator

BOS Chairman

ELECTIVE IV - BIOINSTRUMENTATION

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTE04	Ele-IV	Theory	Y	Y	-	3	3

Learning Objective

- ❖ Practice, experiment with and apply the basic instruments in the laboratory.
- ❖ Predict the functionality of Beer – Lambert's law in identifying and quantifying a biomolecule.
- ❖ Employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.
- ❖ Understand the clinical important isotopes and detection of isotopes.
- ❖ Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Demonstrate the basics of instrumentation by analysis	PO1,PO3
CO2	Exemplify the structure of atoms and molecules by using the principles of Spectroscopy	PO2,PO4
CO3	Evaluate by Separating and Purifying the components	PO5
CO4	understand the need and applications of imaging techniques	PO8
CO5	categorize the working principle and applications of fluorescence and radiation based techniques	PO6,PO7

Unit	Details	No. of Hours
1	pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Phase contrast, Fluorescence Microscope and Electron Microscope.	9
2	Spectra – Absorption and Emission Spectra – Beer Lambert’s law – Colorimeter, UV-Visible Spectrophotometer. Fourier transform Infra-red spectroscopy (FTIR), Nuclear magnetic resonance spectrometer (NMR).	9
3	Chromatography - Principles – Paper Chromatography, TLC, Ion-Exchange, Affinity Chromatography, Gas Liquid Chromatography and HPLC. Electrophoresis: Principle, Paper Electrophoresis – Cellulose Acetate Electrophoresis - Agarose Gel Electrophoresis – SDS- PAGE.	9
4	Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity – GM Counters, Scintillation Counters – Autoradiography – Applications.	9
5	Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.	9
Total		45

Text Books

- ❖ Upadhyay and UpadhyayNath. (2009). “Biophysical Chemistry”, Principles and Techniques. Himalaya Publishing House.
- ❖ L.Veerakumari, (2006) “Bioinstrumentation” MJP publishers, Kindle Edition.
- ❖ SkoogD.A.F.James Holler and Stanky,R.Crouch, (2007) “Instrumental Methods of Analysis” Cengage Learning.
- ❖ Palanivelu P, 2000. Analytical Biochemistry & Separation Techniques, 4th edition, Twenty first century publications.
- ❖ Prakash M, 2009. Understanding Bioinstrumentation, 1st edition, Discovery Publishing House Pvt Ltd

Reference Books

- ❖ Keith Wilson, John Walker, (2010). Principles and techniques of Biochemistry and Molecular Biology” (7th edition). Cambridge University Press.
- ❖ David L. Nelson, Michael M Cox. Lehninger (2008). ”Principles of Biochemistry”, Fifth edition W.H. Freeman, New York.
- ❖ Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).
- ❖ L.A Geddes and L.E. Baker (2008) “Principles of Applied Biomedical Instrumentation” Wiley India Third Edition.
- ❖ Sharma B K, 2005. Instrumental Methods of Chemical Analysis, 24th Edition, GOEL Publishing House.

Web Source

- ❖ <https://www.news-medical.net/life-sciences/How-to-Calibrate-a-pH-Meter.aspx>
- ❖ <https://ibidi.com/content/213-phase-contrast>
- ❖ <https://www.technologynetworks.com/analysis/articles/uv-vis-spectroscopy-principle-strengths-and-limitations-and-applications-349865>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	3	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	14	14	14	14	10	15	14	10	15	14	14	14	14
Average	3.0	2.0	2.8	2.8	2.8	2.8	2.0	3.0	2.8	2.0	3.0	2.8	2.8	2.8	2.8

Course Coordinator

BOS Chairman

CORE PRACTICAL IV – LAB IN GENETIC ENGINEERING AND BIOINSTRUMENTATION

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTP04	Core Practical-IV	Practical	-	-	Y	4	4

Learning Objective

- ❖ Isolate the Plasmid DNA and Genomic DNA. and predict the molecular weight of DNA by Agarose gel electrophoresis. Demonstrate working principles of PCR, RFLP and other important Genetic Engineering techniques.
- ❖ Prepare the competent cells and perform bacterial transformation
- ❖ Determine the restriction digestion of DNA and Determine the restriction fragment length polymorphism
- ❖ Practice, experiment with and apply the basic instruments in the laboratory such as weighing balance, pH meter, shaker, incubator etc. in various research processes. Predict the functionality of Beer – Lambert’s law in identifying and quantifying biomolecules.
- ❖ Employ the separation techniques for separating biomolecules based on paper chromatography.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Gain knowledge on isolation techniques	PO1,PO3
CO2	Learn about gene transfer mechanism	PO2,PO4
CO3	Acquire skills in instrument handling	PO5
CO4	Developing and applying the recent technology involved in diagnostic techniques of immunology with instrument	PO8
CO5	Acquires skills in separation techniques	PO6,PO7

Unit	Details	No. of Hours
1	1.Isolation of genomic DNA 2.Isolation of plasmid DNA 3.Isolation of RNA	12
2	4.Production of competent cells for transformation 5.Bacterial transformation	12
3	6.Restriction Digestion of DNA 7.Ligation of digested DNA fragments	12
4	BIOINSTRUMENTATION 8.Preparation of Buffer (Phosphate Buffer) 9.Determination of pH of biological samples using pH meter 10. Estimation of DNA and proteins by UV spectrophotometer.	12
5	11. Chromatographic analysis of sugar, amino acids, lipids by paper chromatography. 12. Chromatographic analysis of sugar, amino acids, lipids by Thin layer chromatography. 13. Separation of chlorophyll pigments by column chromatography technique. 14.Separation of DNA by Agarose Gel Electrophoresis (AGE) 15.Separation of protein by SDS PAGE	12
Total		60

Text Books

- ❖ Laboratory Manual for GENETIC ENGINEERING 1st Edition, Kindle Edition by S. JOHN VENNISON (Author) 2009.
- ❖ Pennington, S.R. and Pun, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pri. Ltd.
- ❖ Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd
- ❖ Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.
- ❖ Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics. Pearson Education Asia.
- ❖ Primrose, S.B. 1998. Principle of genome analysis. 2nd edition. Blackwell Science.

Reference Books

- ❖ Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
- ❖ Friedman, C.P. and Wyatt, J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.

Web Resources

- ❖ Bishop, M.J. and Rawlings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne
- ❖ Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	3	2	2	3	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2
CO3	2	2	3	2	2	3	2	3	2	2	3	2	3	3	2
CO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2
Total	14	10	15	13	11	15	10	15	11	10	15	13	14	14	11
Average	2.8	2.0	3.0	2.6	2.2	3.0	2.0	3.0	2.2	2.0	3.0	2.6	2.8	2.8	2.2

Course Coordinator

BOS Chairman

Skill Enhancement Course - IV
FUNDAMENTALS OF RESEARCH METHODOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTS07	SEC-IV	Theory	Y	Y	-	2	2

Learning Objective

- ❖ Too familiar with Introduction, types and methods of research
- ❖ Students should be able to identify the overall process of designing a research study from its inception to its report
- ❖ Students should understand a general definition of research design
- ❖ Students should know the primary characteristics of quantitative research and qualitative research
- ❖ Students should be able to identify a research problem stated in a study

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	This course aims to inculcate a clear idea of research among students, understand the existing social issues in research, frame hypothesis, design the wet lab procedures and interpret the results.	PO1,PO3
CO2	Learn about Introduction, types and methods of research	PO2,PO4
CO3	Acquiring the skills of scientific reading, writing and presentations of research	PO5
CO4	Analyse the mechanism of separation and imaging techniques	PO8
CO5	Learn the statistical analysis of biological data	PO6,PO7

Unit	Details	No. of Hours
1	Objectives, Motivation to perform research. Types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature- review and its consolidation; Library research; field research; laboratory research.	6
2	Basic concepts of Statistical sampling methods, Sample Size, Sampling Frame, Sampling Error, Characteristics of a good sample, Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages)	6
3	Research Question & Investigation Question, Hypothesis, Qualities of a good Hypothesis, Features of a good research design, Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	6
4	Layout of a Research Paper, Journals in Life Science, Impact factor of Journals, Ethical issues related to publishing: Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline	6
5	Methods to search required information effectively, Reference Software such as Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Softwares for detection of Plagiarism.	6
Total		30

Text Books

- ❖ Research Methods for the Biosciences. Holmes, Moody & Dine. Oxford University Press.
- ❖ Experimental Design for the Life Sciences. Ruxton & Colegrave. Oxford University Press.
- ❖ Robert A. Day (1998), How to Write & Publish a Scientific Paper. Oryx Press; 5 editions
- ❖ Frank D. Bell (1995), Basic Biostatistics: Concepts for the Health Sciences. William C. Brown

Reference book

- ❖ Judith Bell. Doing your research, A guide for first-time researchers in education, health, and social science. 4th edition. Open University press. McGraw Hill education (2005).

Web Sources

- ❖ <https://explorable.com/quantitative-research-design>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CLO1	3	2	3	3	3	3	2	3	2	2	3	3	3	3	3
CLO2	3	2	3	2	2	3	2	3	2	2	3	2	2	2	2
CLO3	3	3	3	3	2	3	2	3	3	2	3	3	3	3	3
CLO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CLO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	15	14	13	15	10	15	13	10	15	14	14	14	14
Average	3.0	2.0	3.0	2.8	2.6	3.0	2.0	3.0	2.6	2.0	3.0	2.8	2.8	2.8	2.8

Course coordinator

BOS Chairman

Skill Enhancement Course – IV
FINGER PRINTS AND EXAMINED

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTS08	SEC-IV	Theory	Y	Y	-	2	2

Learning Objective

- ❖ The basic knowledge of biometric systems
- ❖ To learn about finger prints concepts in crime system

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the importance of fingerprints in Forensic Science.	PO1,PO3
CO2	Describe the importance of document examination.	PO2,PO4
CO3	Understand about various components, which help in determination of the Document.	PO5
CO4	Acquire skill required for handling questioned documents.	PO8
CO5	Analyze the handwriting variations and forgery.	PO6,PO7

Unit	Details	No. of Hours
1	Introduction. History and development of fingerprinting. Histology and formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns.	6
2	Constituents of sweat residue. Locating latent fingerprints and development by physical and chemical techniques and its mechanism.	6
3	Footprints- Introduction, types, development, collection and comparison. Footwear impressions- Introduction, types, location, collection, comparison and significance. Collection of standards.	6
4	Introduction, Definition, History and development of questioned document examination. Forgery- Definition, types and Sections involved. Alterations in documents, including erasures, additions, over-writings and obliterations.	6
5	Printer: Introduction, parts of a printer, types of printers and their working principle Typewriter: Introduction, working principle, parts of a typewriter.	6
Total		30

Text Books

- ❖ C. Champod, C. Lennard, P. Margot and M. Stoilovic, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton (2004).
- ❖ Lee and Gaenslen's, Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013).

REFERENCE BOOKS

- ❖ Albert S. Osborn, Questioned Documents, 2nd Edition
- ❖ R.N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, London (2000).

Web Source

- ❖ Fingerprint Analysis: [Britannica - Dactyloscopy](#)
- ❖ Footwear and Footprints: Maryland Fingerprint - Types of Fingerprints

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	2	2	3	2	2	3	2	2	2	2
CO2	3	2	2	2	2	2	2	3	2	2	3	2	2	2	2
CO3	3	2	2	2	2	2	2	3	2	2	3	2	2	2	2
CO4	3	2	3	3	2	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	12	12	11	12	10	15	12	10	15	12	12	12	11
Average	3.0	2.0	2.4	2.4	2.2	2.4	2.0	3.0	2.4	2.0	3.0	2.4	2.4	2.4	2.2

Course Coordinator

BOS Chairman

Skill Enhancement Course – V
CRYOGENICS AND CRYOBIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTS09	SEC-V	Theory	Y	Y	-	2	2

Learning Objective

- ❖ Introduction to cryobiology and history of cryopreservation progress
- ❖ To understand the factors that influence the cryopreservation outcome
- ❖ The aims of the course are to introduce to students to basic concepts in ice physics and cryobiology
- ❖ To understand Application of Cryobiology
- ❖ apply the fundamental principles of cryobiology to improve current cryopreservation procedures

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	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.	PO1,PO3
CO2	The students will be familiar with the cryobiology fundamental, will have the knowledge to plan cryopreservation procedures involving freezing of biological materials.	PO2,PO4
CO3	Will understand methods of investigation of ice binding proteins, their structure –function relations and their use in cryobiological applications.	PO5
CO4	In addition students will learn debating in organize debate on issues such as genetically modified food and will participate in a demo development of a biotech cryobiology startup.	PO8
CO5	summarize current cryopreservation practices in ART	PO6,PO7

Unit	Details	No. of Hours
1	Introduction to Cryobiology, cryopreservation - natural cryopreservation, temperature, risks, slow, permeable freezing, vitrification, uses freezable tissues, equipment, limitations.	6
2	Liquid nitrogen – uses, safety, production; glass transition-introduction, transition temperature T _g , kauzmann's paradox, the glass transition, specific materials, silica, polymers, mechanism of vitrification, electronic structures; ex-situ conservation; cryoprotectants; cryostasis; neuropreservation.	6
3	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.	6
4	Hibernation, heterothermy, hibernaculum, hypothermia, chilblains, frost bite, trench feet, thermoregulation.	6
5	Application of Cryobiology - cloning, molecular cloning, organ transplantation, sperm bank, semen extender, in-vitro fertilization, embryo transfer, cryosurgery, cryoablation.	6
Total		30

Text books

- ❖ Principles of Cryopreservation by Vitrification" by M. Amini (2023)
- ❖ Cryopreservation" by Z.P. Nagy (2023)
- ❖ Cryopreservation: A Comprehensive Overview, Challenges and Applications" (2022)
- ❖ Cryopreservation: The Art of Freezing Life" (2023)

Reference book

- ❖ Colby Gunn, A comprehensive introduction to Cryobiology, 2017 library press publishing, New York.
- ❖ <http://ndl.iitkgp.ac.in/document>

Web Sources

- ❖ <https://www.sciencedirect.com/journal/cryobiology>
- ❖ <https://en.wikipedia.org/wiki/Cryopreservation>
- ❖ <https://pubmed.ncbi.nlm.nih.gov/14499908/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	3	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	2	3	2	2	3	3	3	2	3	3	2	3	2
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	11	13	14	13	14	11	15	14	10	15	14	13	14	13
Average	3.0	2.2	2.6	2.8	2.6	2.8	2.2	3.0	2.8	2.0	3.0	2.8	2.6	2.8	2.6

Course Coordinator

BOS Chairman

Skill Enhancement Course – V**Hatchery Management**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UBTS10	SEC-V	Theory	Y	Y	-	2	2

Learning Objective

- To Optimize Feed Conversion
- To Improve Hatchability
- To Maintain Strict Biosecurity Standards

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the principles and benefits of efficient poultry farming	PO1,PO3
CO2	Suggest measure for Health care in Poultry	PO2,PO4
CO3	Evaluate the economics of poultry production.	PO5
CO4	Elaborate the poultry Breeder flock management	PO8
CO5	Differentiate the poultry hatchery practices	PO6,PO7

Unit	Details	No. of Hours
1	History of Natural and Artificial incubation – embryo development - Collection, selection and care of hatching eggs – Hatchery management – fumigation and sanitation – incubation practices – temperatures – humidity – turning – ventilation, position, etc.	6
2	Care of day old chicks and their vaccination –Restricted & controlling feeding of breeders – Sex separate feeding and nutrient supplementation. Seasonal management of breeders – Location of hatchery –Layout and design of breeder houses, hatchery & other buildings.	6
3	Incubation practices – Types of incubators – Hatchery routines ; setting, candling, transferring, vaccination, hardening, sexing, grading, etc Factors affecting fertility and hatchability – Bio security maintenance in hatchery.	6
4	Biosecurity, health management and waste disposal – Vaccination & medication schedule for breeders. Control of vertically transmissible & hatchery borne disease. Principles of bio security – Farm sanitation and disinfection procedures – Common bacterial, viral and fungal diseases.	6
5	Hatching egg & SPF egg import and export regulations – Maintaining Salmonella and Mycoplasma free breeding flock- Application of HACCP and good management practices (GMP) in hatchery management for better chick quality.	6
Total		30

Text books

- ❖ "Embryo Development and Hatchery Practice in Poultry Production" (2023), Burleigh Dodds Science Publishing.
- ❖ "Textbook of Poultry Management Practices" (2023), Tom Tabler, American Academic Publisher
- ❖ "Poultry Production & Hatchery Management" (2019), Dr. M.T. Banday & Dr. S. Adil, Satish Serial Publishing House.

References book

- ❖ HVS Chauhan, S. Roy, Poultry Diseases, Diagnosis and Treatment, New Age International Publishers-2018

Web resources

- ❖ <https://www.drvet.in/p/e-books.html>
- ❖ <https://byjus.com/biology/animal-husbandry-poultry-farming/>
- ❖ https://www.helpforag.app/2018/02/livestock-production-and-management-lpm_14.html?m=1

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	2	2	2	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	2	3	2	3	3	2	3	3	3	3	2
CO3	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3
Total	15	10	14	14	13	14	10	15	14	10	15	14	14	14	14
Average	3.0	2.0	2.8	2.8	2.6	2.8	2.0	3.0	2.8	2.0	3.0	2.8	2.8	2.8	2.8

Course Coordinator

BOS Chairman

EVS- ENVIRONMENTAL STUDIES

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UES01	EVS	Theory	Y	-	-	1	2

Learning Objectives

- ❖ Identify and describe the natural and human-made components of the environment.
- ❖ Explain the relationships between living organisms and their environment.
- ❖ Recognize and describe major environmental problems, such as pollution and climate change.
- ❖ Adopt environmentally friendly behaviors and practices in daily life.
- ❖ Appreciate the importance of environmental conservation and sustainability.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To understand the multi-disciplinary nature of environmental studies and its importance	PO1, PO4, PO6, PO9
CO2	To obtain knowledge on different types of ecosystem	PO1, PO4, PO5, PO7
CO3	To acquire knowledge on Renewable and non-renewable resources, energy conservation	PO1, PO4, PO5, PO6 PO4,
CO4	To understand biodiversity conservation	PO7,PO9
CO5	To analysis impact of pollution and conversion waste to products	PO5, PO6, PO7,PO9

Unit	Details	No. of Hours
I	Introduction to environmental studies Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable level.	6
II	Ecosystems What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Types of ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	6
III	Natural Resources: Renewable and Non-renewable Resources Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	6
IV	Biodiversity and Conservation Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	6
V	Unit 5: Environmental Pollution	6

	Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Energy from waste, value added products from waste, fly ash utilization and disposal of garbage, solid waste management in urban and rural areas, recent advances in solid waste management, Swachh Bharat Abhiyan. Modern techniques in rain water harvesting and utilization.	
VI	Unit 6: Environmental Policies & Practices Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context	
VII	Unit 7: Human Communities and the Environment Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Disaster management: floods, earthquakes, cyclones and landslides. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness.	
VIII	Unit 8: Field work Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, Delhi Ridge, etc.	
	Total	30

Text Books

- ❖ "Textbook of Ecology and Environmental Pollution" (2023), American Academic Publisher
- ❖ "Environmental Studies" (2024), Sultan Chand & Sons
- ❖ "Environmental Science" (Third Edition), BIOZONE

Reference Book

- ❖ Environmental Studies: From Crisis to Cure, 2020, R. Rajagopalan, Oxford University Press
- ❖ Principles of Environmental Science, William Cunningham & Mary Cunningham, McGraw-Hill Education and 2021

Web Source

- ❖ University of Minnesota - Introduction to Environmental Sciences and Sustainability
- ❖ Creighton University - Environmental Studies Notes
- ❖ Teresa's College - Environmental Studies Lecture Notes

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	0	2	0	3	0	0	3	0	3	3	3	3	3
CO2	3	0	0	2	2	0	0	3	0	3	3	3	3	3	3
CO3	3	0	0	3	3	0	3	2	3	2	3	3	3	3	3
CO4	3	2	2	3	3	0	0	0		0	3	3	3	3	3
CO5	3	0	0	3	2	2	0	0	3	0	3	3	3	3	3
Total	15	2	2	13	10	5	3	5	9	5	15	15	15	15	15
Average	3.0	0.4	0.4	2.6	2.0	1.0	0.6	1.0	1.8	1.0	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

SEMESTER – V

THIRD YEAR – SEMESTER – V

CORE PAPER VI- PLANT BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBT06	Core-VI	Theory	Y	Y	-	5	4

Learning Objectives

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

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Acquire the knowledge about the techniques of Plant Tissue Culture, Lab. organization & measures adopted for aseptic manipulation	PO1, PO4, PO6, PO8, PO10
CO2	Acquire the knowledge about the nutritional requirements of cultured tissues.	PO1, PO3, PO4, PO6, PO8
CO3	Learn the large scale clonal propagation of plants through various micro propagation techniques, Production of secondary metabolites under in vitro conditions	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	A good understanding of r-DNA technology, methods of gene transfer, molecular markers and marker assisted selection	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	Develop transgenic resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	History of plant biotechnology. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.	15
2	Plant Growth regulators – phytochrome – role in photomorphogenesis – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.	15
3	Media composition (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation, fusion and culture, Synthetic seed production. Secondary metabolite production.	15
4	Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti and Ri Plasmid vectors and their utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.	15
5	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

- ❖ Sudhir, M. 2000. Applied Biotechnology and plant Genetics. Dominant publishers and distributors. Kannan, I., 2010. Immunology. MJP Publishers, Chennai
- ❖ Trivedi, P.C. 2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.
- ❖ Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
- ❖ Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.
- ❖ Chawla, H.S., “Introduction to Plant Biotechnology”, 3rd Edition, Science Publishers, 2009.

Reference Books

- ❖ Kojima, Lee, H. and Kun, Y. 2001. Photosynthetic microorganisms in Environmental Biotechnology. Springer – Verlag.
- ❖ Stewart Jr., C.N., “Plant Biotechnology and Genetics: Principles, Techniques and Applications” Wiley-Interscience, 2008.
- ❖ Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
- ❖ Trigiano, R.N. and Gray, D.J. 1996. Plant tissue culture concepts and laboratory exercise. CRC Press. BocaRatin, New York.
- ❖ Street, H.E. 1977. Plant tissue culture. Blackwell Scientific Publications, oxford, London.

Web Resources

- ❖ <https://nptel.ac.in/courses/102103016>
- ❖ <https://science.umd.edu/classroom/bsci124/lec41.html>
- ❖ <https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology>
- ❖ <http://mydunotes.blogspot.com/p/plant-biotechnology.html>
- ❖ <https://nptel.ac.in/courses/102103016>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	1	1	2	-	2	1	2	-	1	3	1	1	2	2
CO2	3	1	2	2	1	2	-	2	-	1	3	2	1	2	2
CO3	3	1	2	3	2	3	1	3	-	2	3	2	3	3	2
CO4	3	1	3	3	3	3	1	3	-	2	3	3	3	3	3
CO5	3	2	3	3	3	3	1	3	1	2	3	3	3	3	3
Total	15	6	11	13	9	13	4	13	1	8	15	11	11	13	12
Average	3.0	1.2	2.2	2.6	1.8	2.6	0.8	2.6	0.2	1.6	3.0	2.2	2.2	2.6	2.4

Course Coordinator

BOS Chairman

CORE PAPER IX- ANIMAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBT07	Core-VII	Theory	Y	Y	-	5	4

Learning Objectives

- ❖ Understand the basic concepts of Animal cell culture and cell laboratory.
- ❖ Describe the media preparation, preservation, trypsinization, counting, maintenance and application of cell lines.
- ❖ Discuss the strategies for gene transfer and gene expressions with their applications.
- ❖ Be acquainted with genetic modification and stem cell technology in production of transgenic animals.
- ❖ Learn the Assisted reproductive technology and its applications.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To develop an understanding on basic pattern of animal cell culture and controlling characters	PO1, PO3, PO4, PO6, PO8
CO2	To gain knowledge on the infrastructure requirements for animal cell culture like laboratory layout & design, equipment's, substrates and media requirements for animal cell culture, properties of animal cell culture medium and maintenance of aseptic condition.	PO1, PO4, PO6, PO8, PO10
CO3	Understand the gene transfer technology and gene expression	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	Understand the transgenic animal and stem cell technology	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	Highlight the applications of animal biotechnology in various fields	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	Animal cell culture – History and development, 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 equipment's required for animal cell culture.	15
2	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, and cryopreservation.	15
3	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. MTT assay.	15
4	Protein production by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products - Transgenic Animals.	15
5	Collection and preservation of embryos, Semen banking, AI, IVF, IVF Regulation and ethics, and ICSI.	15
Total		75

Text Books

- ❖ Ramasamy.P. 2002. Trends in Biotechnology, University of Madras of Publications, Pearl Press
- ❖ Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.
- ❖ K. Srivastava *et al.*, 2009, Animal Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd.
- ❖ B.C. Currell *et al.*, 1994, In vitro Cultivation of Animal Cells (Biotol), Butterworth-Heinemann Ltd.
- ❖ Jenkins, N. (ed). 1999 Animal cell Biotechnology: Methods and protocols. Humana press, New Jersey.

Reference Books

- ❖ R. Ian Freshney, Culture of Animal cells – A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications.
- ❖ Glick, B.R. and Pasternak. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA.
- ❖ Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington.
- ❖ Traven. 2001. Biotechnology. Tata McGraw – Hill.
- ❖ Walker, J.M. and Gingold, E.B. 1999. Molecular biology and Biotechnology, 3rd edition. Panima Publishing Corporation.

Web Resources

- ❖ <http://ecoursesonline.iasri.res.in/course/view.php?id=350>
- ❖ <https://microbenotes.com/animal-cell-culture/>
- ❖ https://biocyclopedia.com/index/biotechnology/animal_biotechnology/manipulation_of_reproduction_and_transgenic_animals/biotech_in_vitro_fertilization_technology.php
- ❖ <https://thebiologynotes.com/embryo-transfer/>
- ❖ <https://people.ucalgary.ca/~browder/transgenic.html>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	-	2	2	-	2	-	2	-	-	3	2	-	2	-
CO2	3	-	2	3	-	2	-	2	-	2	3	2	-	3	2
CO3	3	-	3	3	2	3	-	3	-	2	3	3	2	3	2
CO4	3	-	3	3	2	3	-	3	-	2	3	3	3	3	2
CO5	3	2	3	3	3	3	1	3	-	2	3	3	3	3	3
Total	15	2	13	14	7	13	1	13	0	8	15	13	8	14	9
Average	3.0	0.4	2.6	2.8	1.4	2.6	0.2	2.6	0.0	1.6	3.0	2.6	1.6	2.8	1.8

Course Coordinator

BOS Chairman

ELECTIVE V- NANO BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE05	ELE-V	Theory	Y	Y	-	4	3

Learning Objective

- ❖ The students will get an outline about Nano biotechnology and its research in India.
- ❖ To know about nanoparticles and their analysis using Advanced Instrumentation.
- ❖ To get an insight about Nano devices
- ❖ The students will know about the Applications of Nano biotechnology
- ❖ The students will know about the Nano Biosensors and their applications.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	The student will develop a fundamental knowledge of Nano biotechnology	PO1, PO3, PO6, PO8, PO10
CO2	Understand the various types of nanoparticle characterization techniques.	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO3	The student will develop a fundamental knowledge of nanomaterials	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	The detail understanding of the importance of nanoparticles and its application in Nano biotechnology	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	The detail understanding of nano biosensors and their applications	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10

Unit	Details	No. of Hours
1	Introduction to nanotechnology and Nano biotechnology; history and evolution of nanotechnology; nanoscale materials (1–100 nm); classification of nanomaterials (0D, 1D, 2D and 3D); unique properties of nanomaterials. Scope and applications of Nano biotechnology.	12
2	Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM	12
3	Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells-Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics.	12
4	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.	12
5	Nano biosensors (Firefly-luciferase) and its applications. Nano application in Environmental, Agriculture, medical, and Bioremediation.	12
Total		60

Text Books

- ❖ Vasantha Pattabhi and N. Gautham (2009), Biophysics, Narosa Publishing House, New Delhi.
- ❖ Narayanan.P (2010), Essentials of Biophysics, New Age International (P) Ltd. Publishers, New Delhi.
- ❖ Rai, Mahendra, and Clemens Posten (2013). *Green biosynthesis of nanoparticles: Mechanisms and applications*, CABI, ISBN: 9781780642246.
- ❖ Shanmugam.S, "Nanotechnology", MJP publishers, 2010.
- ❖ Pradeep T (2012). *Textbook of Nanoscience and Nanotechnology*, McGraw Hill publications, ISBN: 9781259007323.

Reference Books

- ❖ D.Voet & J.G.Voet (2010), Biochemistry, John Wiley & Sons, New York.
- ❖ Biochemistry by Lubert Stryer, 4th Ed., WH.Freeman, 1995.
- ❖ David S. Goodsell, “Bionanotechnology”, John Wiley & Sons Inc., publications, 2004.
- ❖ Guozhong Cao (2004). Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial College Press, ISBN: 978-1860944802.
- ❖ C.M.Niemeyer, C.A. Mirkin (2007). *Nanobiotechnology*, WILEY-VCH Verlag GmbH & Co. KG, Weinheim, ISBN: 9783527306589.

Web Resources

- ❖ http://vvm.org.in/study_material/ENG%20-20Indian%20Contributions%20to%20Science.
- ❖ https://www.jabonline.in/admin/php/uploads/16_pdf.pdf
- ❖ <https://www.youtube.com/watch?v=gSpHINVmgoE>
- ❖ <https://www.youtube.com/watch?v=ITtGJUGXFKc>
- ❖ <https://www.youtube.com/watch?v=4cGROrskvLM>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	1	1	1	-	2	-	2	-	1	3	1	-	2	1
CO2	3	1	2	2	2	3	-	3	-	3	3	2	2	3	2
CO3	3	1	2	2	2	2	-	2	-	2	3	2	2	2	2
CO4	3	1	3	3	2	3	-	3	-	2	3	3	2	3	3
CO5	3	2	3	3	3	3	1	3	-	3	3	3	3	3	3
Total	15	6	11	11	9	13	1	13	0	11	15	11	9	13	11
Average	3.0	1.2	2.2	2.2	1.8	2.6	0.2	2.6	0.0	2.2	3.0	2.2	1.8	2.6	2.2

Course Coordinator

BOS Chairman

ELECTIVE V – ENZYMOLOGY AND ENZYME TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE06	ELE-V	Theory	Y	Y	-	4	3

Learning Objective

- ❖ The students will learn the Fundamentals of Enzymology.
- ❖ The students will study about the characteristic features of Enzymes.
- ❖ The student will know about the details of Enzyme Kinetics.
- ❖ The student will apply the biochemical techniques for enzyme isolation.
- ❖ The Student will understand the process of Immobilization of enzymes, Enzymeengineering and Designer enzymes in various Industrial purposes.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms	PO1, PO3, PO6, PO8, PO10
CO2	Understand the characteristic features of enzymes	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO3	Get an overall understanding the enzyme kinetics	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	To know the biochemical techniques for enzyme isolation	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO10
CO5	Understand the process of Immobilization of enzymes, Enzyme engineering and Designer enzymes in various Industrial purposes.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10

Unit	Details	No. of Hours
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).	12
2	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.	12
3	Enzyme Kinetics – Michaelis-Menten equation and its derivation, significance of Km and Vmax, Lineweaver- Burk plot. Enzyme inhibition - competitive, Non- competitive, Uncompetitive – (Derivations not included). Allosteric inhibition, feedback inhibition.	12
4	Membrane bound proteins – Fluid mosaic model. Extraction of enzymes – Chemical agents and Physical methods of extraction, ultrasonication. Nature of the extraction medium. Technique for enzyme isolation, purification of enzymes- dialysis, chromatography, electrophoresis. Intracellular localization of enzymes and marker enzymes.	12
5	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.	12
Total		60

Text Books

- ❖ Satyanarayana. U. 2013. Biochemistry. 4th edition, Elsevier India.
- ❖ Jain J L, 2014, Fundamentals of Biochemistry, 7th edition, S.Chand publishing.
- ❖ Rodwell, V.W, Bender D.A, Botham K.M. 2015, Harper's Illustrated Biochemistry, 30th edition. McGraw-Hill Education.

- ❖ Fundamentals of Enzymology - Nicholas C. Price and Lewis Stevens., Oxford University Press, New Delhi.
- ❖ Voet, D. and Voet, J.G. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,

Reference Books

- ❖ Enzyme – Palmer, 18th edition, 2004. London: Portland Press
- ❖ Biochemistry- Jeremy M Berg, John L Tymoczko, and Lubert Stryer, 6th Edition, Freeman Publications, 2006.
- ❖ Ralph A. Messing (2012) Immobilised Enzymes Academic Press, NY.
- ❖ Nelson D.L., and Cox, M.M. 2013. Lehninger Principles of Biochemistry. 6th edition. W.H. Freeman & Company.
- ❖ Jeremy M Berg, Stryer, L. 2015. Biochemistry, 8th edition. Macmillan Learning.

Web Resources

- ❖ <https://www.youtube.com/watch?v=AD3-v1oKjSk>
- ❖ <https://www.youtube.com/watch?v=tPCOEUo6J8s>
- ❖ <https://www.youtube.com/watch?v=ALwziZSRiqM>
- ❖ <https://www.youtube.com/watch?v=0ZiCqwtFMTs>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	1	1	1	-	2	-	2	-	1	3	1	-	2	1
CO2	3	1	2	2	1	2	-	2	-	1	3	2	1	2	1
CO3	3	1	3	2	3	2	-	3	-	2	3	3	2	3	2
CO4	3	1	2	3	2	3	1	3	-	2	3	2	3	3	3
CO5	3	2	3	3	3	3	1	3	-	2	3	3	3	3	3
Total	15	6	11	11	9	12	2	13	0	8	15	11	9	13	10
Average	3.0	1.2	2.2	2.2	1.8	2.4	0.4	2.6	0.0	1.6	3.0	2.2	1.8	2.6	2.0

Course Coordinator

BOS Chairman

ELECTIVE V – PHARMACEUTICAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE07	ELE-V	Theory	Y	Y	-	4	3

Learning Objective

- ❖ Students will understand the series of processes involved in drug development, patenting and drug approval.
- ❖ Will learn about Biopharmaceuticals
- ❖ Will become familiar with Biotech protein drugs
- ❖ Will understand about management of drugs
- ❖ Will be familiar with Pharmaceutical sectors

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Compare and contrast the specific pharmacology of the major classes of drugs, important distinctions among members of each class	PO1, PO3, PO5, PO8
CO2	Getting the knowledge for the biotech protein products	PO1, PO3, PO4, PO6, PO8
CO3	Getting the knowledge for the biological important products	PO1, PO3, PO4, PO6, PO8, PO10
CO4	Understand the medicinal and pharmaceutical importance of drug compounds Analyze the fundamental principles of pharmacokinetics and pharmacodynamics.	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	To know the Scope and career opportunities in pharmaceutical sectors.	PO1, PO2, PO6, PO9, PO10

Unit	Details	No. of Hours
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.	12
2	Production of recombinant proteins - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery – basics of Pharmacognosy .	12
3	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).	12
4	Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management. Ethno medicine and AMR mechanism.	12
5	National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors.	12
Total		60

Text Books

- ❖ Chandrakant Kokate and Pramod H.J 1st Edition (2011), Text Book of Pharmaceutical Biotechnology, Elsevier
- ❖ Crommelin, Dean J. A., Sindelar, Robert, Meobohm, Bernd (Eds.) (2019), Pharmaceutical Biotechnology: Fundamentals and Applications, Springer.
- ❖ Ashish Dixit, Pawan Tiwari and Vivekanand Kishan Chatap (2015), Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd.
- ❖ John F. Corpenner, Mark C. Manning (2012). *Rational Design of stable formulation Theory and Practice*, (1st edition), US: Springer Science, ISBN: 9781461351313.

Reference Books

- ❖ Gary Walsh (2003), Biopharmaceuticals ; biochemistry and Biotechnology, JohnWiley & Sons Ltd.

- ❖ Oliver Kayser and Heribert Warzecha (2012), *Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications*, Wiley - Blackwell.
- ❖ Oliver Kayser and Heribert Warzecha (2012), *Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications*, Wiley - Blackwell.
- ❖ Hiten J. Gutka, Harry Yang, Shefali Kakar (2018). *Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development*, (1st ed), USA: Springer, ISBN:978-3-319-99679-0.
- ❖ 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

- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/>
- ❖ https://www.patentdocs.org/biotech_news/
- ❖ <https://www.pharmamanufacturing.com/>
- ❖ <https://www.parexel.com/>
- ❖ <https://nptel.ac.in/courses/102/103/102103013/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	-	3	-	2	-	-	3	-	-	3	3	-	2	-
CO2	3	-	2	2	-	2	-	2	-	-	3	2	-	2	2
CO3	3	-	2	2	-	2	-	2	-	2	3	-	2	2	2
CO4	3	-	3	3	3	2	-	3	-	2	3	2	2	3	3
CO5	2	3	-	-	-	2	-	-	2	2	-	2	-	-	3
Total	14	3	10	7	5	8	0	10	2	6	12	9	4	9	10
Average	2.8	0.6	2.0	1.4	1.0	1.6	0.0	2.0	0.4	1.2	2.4	1.8	0.8	1.8	2.0

Course Coordinator

BOS Chairman

ELECTIVE VI – BIOFARMING

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE08	ELE-VI	Theory	Y	Y	-	4	3

Learning Objective

- ❖ To provide knowledge on the basics of conventional cropping systems and natural farming.
- ❖ To learn the types of farming
- ❖ To learn the role of pest management
- ❖ To provide the knowledge on organic farming.
- ❖ To learn the concepts of organic agricultural policy and GMOs

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the principles of conventional cropping systems and natural farming	PO1, PO3, PO4, PO8
CO2	Understand the knowledge about green revolution in India	PO1, PO2, PO3, PO8, PO9
CO3	Manipulate integrated pest management for the development of pesticide free plant products	PO1, PO3, PO4, PO5, PO6, PO8
CO4	Develop the concepts of organic farming	PO1, PO3, PO4, PO6, PO8
CO5	Understand the concepts of organic agricultural policy and GMOs	PO1, PO2, PO3, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	Agro-ecological zones and geographical distribution of crop plants in Tamil Nadu. Cropping systems - different types and their importance in food production- Package and practices followed for major crops and cropping systems in Tamil Nadu	12
2	Green revolution in India - After effects - Definitions of Natural Farming, Traditional farming - Their concepts and scope - Natural Farming -Institutions- their activities and role.	12
3	Pest - Definition - categories of pests-pest control - natural, artificial- pest management IPM. Store grain pest management. Pesticides consumption and hazards. Role of biopesticides and biofertilizers in IPM.	12
4	Organic farming - concept and relevance in the agriculture - problems and remedies - Encouragement and dissemination for effective practicing of organic farming. Production and marketing of Organic products.	12
5	Organic agriculture policy, Genetically Modified Organisms as organic regulation. Pesticide residues, environmental culture and different types farming.	12
Total		60

Text Books

- ❖ Basu, D.N. and Guha, G.S. (1996). Agroclimatic regional planning in India, ARPU, Ahmedabad
- ❖ Krishna, K. R., (2010). Agroecosystems of south India, Brownwalker press, Florida
- ❖ John H. Perkins, Geopolitics and the Green Revolution: Wheat, Genes, and the ColdWar, Oxford University Press, 1997.
- ❖ Lester R. Brown, Seeds of Change: The Green Revolution and Development in the 1970's, 1970, Praeger Publishers, New York.

Reference Books

- ❖ Kogan, M 1998. Integrated Pest Management: Historical Perspectives and Contemporary Developments, Annual Review of Entomology Vol. 43: 243-270 (Volume publication date January 1998).
- ❖ Dharam P. Abrol (Editor), Uma Shankar 2013. Integrated Pest Management: Principles and

Practice Amazon text book store NPCS Board of Consultants & Engineers, (2008). The complete book on organic farming and production of organic compost, Asia Pacific Business Press Inc.

❖ Shalini Suri, APH, (2012). Organic farming Vedams books from India.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	2	0	0	0	2	0	0	3	2	1	2	0
CO2	3	2	2	0	0	0	0	2	2	0	2	2	0	2	0
CO3	3	0	3	3	2	3	1	3	0	0	3	3	3	3	2
CO4	3	0	2	3	0	2	0	3	0	0	3	2	2	3	1
CO5	3	2	2	0	2	2	0	2	0	2	2	3	2	2	2
Total	15	4	11	8	4	7	1	12	2	2	13	12	8	12	5
Average	3.0	0.8	2.2	1.6	0.8	1.4	0.2	2.4	0.4	0.4	2.6	2.4	1.6	2.4	1.0

Course Coordinator

BOS Chairman

ELECTIVE VI – BIOETHICS, BIOSAFETY & IPR

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE09	ELE-VI	Theory	Y	Y	-	4	3

Learning Objective

- ❖ The students will understand the concepts of Bioethics and Biosafety.
- ❖ The students will realize the impact of Gene cloning in societal problems and also understand the need of the Bioethics.
- ❖ The students will know about the importance of Ethical Clearance.
- ❖ The students will get knowledge about Patents Rights in the field of Research.
- ❖ The students will know about Biosafety and GLP.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life	PO1, PO2, PO3, PO8, PO9
CO2	To understand the impact of Gene cloning in societal problems	PO1, PO2, PO3, PO4, PO8, PO9
CO3	Understand ethical aspects related to biological, biomedical, health care and biotechnology research.	PO1, PO2, PO3, PO6, PO8, PO9
CO4	To get knowledge about Patents Rights	PO1, PO2, PO3, PO5, PO10
CO5	To understand Biosafety and GLP	PO1, PO3, PO4, PO6, PO8, PO10

Unit	Details	No. of Hours
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.	12
2	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).	12
3	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.	12
4	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.	12
5	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 - .	12
Total		60

Text Books

- ❖ Ignacimuthu, S (2009), *Bioethics*, Narosa Publication house, ISBN:978-81-7319-966-0
- ❖ V. Sree Krishna . V (2007), *Bioethics and Biosafety in Biotechnology*, (1st ed.), New Age International Private Limited.
- ❖ Rhona Smith. (2003), *International Human rights*, Blackstone Press.
- ❖ Manual of patent practice and procedure. IPR India, 2005.
- ❖ Ministry of commerce and industry, New Delhi, pp.163.

Reference Books

- ❖ Trayer, P.C, Fredrick.R., and Koch, M. (2002), *Biosafety*. Michigan State University
- ❖ Biosafety, Traylor, Fredric & Koch, 2002. Michigan state University pub., USA.
- ❖ Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California.
- ❖ Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333

Web Resources

- ❖ www.ipr-helpdesk.org/
- ❖ www.patentoffice.nic.in/ipr/patent/patents.htm
- ❖ www.bangalorebio.com/GovtInfo/ipr.htm

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	0	0	0	0	2	3	0	2	3	0	2	1
CO2	3	2	3	2	0	0	0	2	2	0	2	3	1	2	1
CO3	3	2	3	0	0	2	0	2	3	0	2	3	1	3	2
CO4	3	2	2	0	2	0	0	0	0	3	2	2	1	2	2
CO5	3	0	2	2	0	2	0	3	0	2	3	2	2	3	2
Total	15	8	12	4	2	4	0	9	8	5	11	13	5	12	8
Average	3.0	1.6	2.4	0.8	0.4	0.8	0.0	1.8	1.6	1.0	2.2	2.6	1.0	2.4	1.6

Course Coordinator

BOS Chairman

ELECTIVE VI – DAIRY SCIENCE AND TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTE10	ELE-VI	Theory	Y	Y	-	4	3

Learning Objective

- ❖ Gain information about spoilage of milk and its products and its antimicrobial properties
- ❖ Learn about the various fermented product and its various stage spoilage
- ❖ Learn about functional dairy food products
- ❖ Impart current knowledge of probiotics
- ❖ Impart current knowledge of prebiotics and functional dairy foods for the health benefits

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To gain information about microflora of milk	PO1, PO3, PO6, PO8
CO2	To study about the production of fermented dairy products	PO1, PO3, PO4, PO6, PO8
CO3	To study the functional dairy foods for the health benefits	PO1, PO3, PO4, PO5, PO6, PO8
CO4	To impart current knowledge of probiotics, prebiotics	PO1, PO3, PO5, PO6, PO8, PO10
CO5	To create a sustainable environmentally and technologically advanced dairy farm	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO10

Unit	Details	No. of Hours
1	Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.	12
2	Dairy products- milk, butter, ghee, and ice cream. Fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, and Koumiss).	12
3	Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.	12
4	Probiotic & prebiotics microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics.	12
5	Livestock Diseases: Introduction to livestock diseases; common diseases of dairy cattle and buffaloes including Foot-and-Mouth Disease (FMD), Mastitis, Brucellosis, Hemorrhagic Septicemia (HS).	12
Total		60

Text Books

- ❖ Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
- ❖ Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.
- ❖ Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGrawHill Publishing Company Ltd. New Delhi.

Reference Books

- ❖ Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk andMilk Products (Third Edition), A John Wiley & Sons, Inc., New York.
- ❖ Yuankunlee, Sepposalminen. (2008). Handbook of probiotics and prebiotics SecondEdition. A John Wiley & Sons publication Inc.
- ❖ Dharumaurai Dhansekaran, Alwarappan Sankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

Web Resources

- ❖ https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/download
- ❖ <https://www.fda.gov/food>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	0	0	2	0	2	0	0	3	1	0	2	1
CO2	3	0	2	2	0	2	0	2	0	0	3	2	1	2	2
CO3	3	0	2	2	2	2	0	2	0	0	3	2	2	2	2
CO4	3	0	2	0	2	2	0	3	0	2	3	3	2	3	2
CO5	3	0	3	3	3	3	2	3	0	2	3	3	3	3	3
Total	15	0	11	7	7	11	2	12	0	4	15	11	8	12	10
Average	3.0	0.0	2.2	1.4	1.4	2.2	0.4	2.4	0.0	0.8	3.0	2.2	1.6	2.4	2.0

Course Coordinator

BOS Chairman

CORE PRACTICAL V- PLANT BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTP05	Core Practical V	Practical	-	-	Y	4	3

Learning Objectives

- ❖ Explain plant tissue culture and Illustrate Callus development.
- ❖ To examine the culture techniques of the plant tissue in-vitro and its applications
- ❖ Develop technical skills in isolation of DNA and RNA from plants and microorganisms.
- ❖ Develop technical skills in Protoplast isolation
- ❖ To point out the genomic isolation technique

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To gain knowledge on the media preparation and techniques	PO1, PO4, PO6, PO8, PO10
CO2	Learning different pathways of plant regeneration under in vitro conditions	PO1, PO3, PO4, PO6, PO8
CO3	To learn haploid production	PO1, PO3, PO4, PO5, PO6, PO8
CO4	Learn plant regeneration from protoplast isolation	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	To isolate the DNA from plant	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	1. Plant tissue culture media preparation & sterilization techniques. 2.Explant Preparation	12
2	3. Seed germination 4 Establishment and maintenance of callus culture 5.Shoot tip initiation	12
3	6.Root initiation using MS media 7.Anther culture 8.Pollen Culture	12
4	9.Embryo culture 10. Isolation of plant protoplast & viability test	12
5	11. Synthetic seeds (Entrapment method). 12. Isolation of plant DNA	12
Total		60

Text Books

- ❖ Madhavi Adhav, 2009, Practical Biotechnology and Plant Tissue Culture, S.Chand &Company Ltd.
- ❖ C. C. Giri, Archana Giri, 2007, Plant Biotechnology: Practical Manual, I.K. International Pvt Ltd.
- ❖ Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009, Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application, Springer.
- ❖ Debajit Borah (2018), *Environmental Biotechnology Theory and Lab Practices*, (2nd edition), Hardcover – Global Vision Publishing House, ISBN: 9788182205840

Reference Books

- ❖ S. Lal, Vikas. (2018), *Public Health Management Principles And Practice*, (2nd Edition), CBS Publishers and Distributors Pvt Ltd, ISBN 13: 9789387742932
- ❖ S. Harisha. (2012), *Biotechnology procedures and experiments handbook*, ISBN13 9781934015117

Web Resources

- ❖ <https://www.plantcelltechnology.com/pct-blog/different-types-of-tissue-culture- processes/>
- ❖ <https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	1	3	0	3	0	2	0	2	3	1	1	3	2
CO2	3	0	2	3	0	3	0	2	0	0	3	2	1	3	2
CO3	3	0	2	3	2	3	0	3	0	0	3	2	2	3	2
CO4	3	0	3	3	2	3	1	3	0	2	3	3	3	3	3
CO5	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
Total	15	0	11	15	7	15	1	13	0	6	15	11	10	15	12
Average	3.0	0.0	2.2	3.0	1.4	3.0	0.2	2.6	0.0	1.2	3.0	2.2	2.0	3.0	2.4

Course Coordinator

BOS Chairman

CORE PRACTICAL VI- ANIMAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S5UBTP06	Core Practical VI	Practical	-	-	Y	4	3

Learning Objectives

- ❖ Make use of the techniques used in preparing tissue culture medium and membrane filtration in culturing animal cells
- ❖ Prepare single cell suspension and evaluate cell counting and viability.
- ❖ To probe into the animal cell culture techniques
- ❖ Examine the importance of trypsinization in monolayer and subculture and cryopreservation.
- ❖ To point out the genomic isolation technique

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Learn about the culture media used in animal cell culture.	PO1, PO4, PO6, PO8, PO10
CO2	Gain the knowledge on Preparation of media for animal cell culture.	PO1, PO4, PO6, PO8, PO10
CO3	Primary culture of chick embryo fibroblasts. Primary culture of chick organ - spleen and kidney cells	PO1, PO3, PO4, PO5, PO6, PO7, PO8
CO4	Gain the knowledge on proliferative assay	PO1, PO3, PO5, PO6, PO8, PO10
CO5	To point out the genomic isolation technique	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	1.Preparation of Animal Tissue culture media AND membrane filtration 2.Preparation of Single Cell Suspension from spleen	12
2	3. Dissection of FISH 4.Cell counting Cell viability Test	12
3	5. Culture of chick embryo fibroblast (monolayer). 6.Trypsinization of monolayer and sub culturing (Demo)	12
4	7.MTT Assay (Demo)	12
5	8. Isolation of DNA from animal tissue	12
Total		60

Web Resources

- ❖ <https://www.mooc-list.com/course/cell-culture-basics-canvasnet>
<https://nptel.ac.in/courses/102/104/102104059/>
- ❖ <https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	1	3	0	3	0	2	0	2	3	1	1	3	2
CO2	3	0	1	3	0	3	0	2	0	2	3	1	1	3	2
CO3	3	0	3	3	2	3	2	3	0	0	3	2	3	3	2
CO4	3	0	2	1	3	2	0	3	0	2	3	2	2	3	2
CO5	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
Total	15	0	10	13	8	14	2	13	0	8	15	9	10	15	11
Average	3.0	0.0	2.0	2.6	1.6	2.8	0.4	2.6	0.0	1.6	3.0	1.8	2.0	3.0	2.2

Course Coordinator

BOS Chairman

SEMESTER – VI

THIRD YEAR

SEMESTER – VI

Core Paper X - ENTREPRENEURSHIP IN BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBT10	Core-X	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Students will be able to identify the challenges of being a Bioentrepreneur
- ❖ Will understand the Business proposal for starting a company
- ❖ Will learn about the process of biogas production
- ❖ Will aspire to set up biofertilizer production
- ❖ Will learn the technique of Single cell protein Cultivation

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To be familiar with the different schemes offered by Government institutions to support entrepreneurs and also provides the basic knowledge on project proposal preparation, feasibility analysis, execution and management.	PO1, PO3, PO4, PO6, PO10
CO2	To have a fundamental idea about the principles of management, learn to make a business proposal, arrange for financial resources and maintenance of business establishment by accounting practices and other essential concepts required for executing a business plan.	PO1, PO2, PO3, PO4, PO5, PO10
CO3	Understand the process of biogas production and its application	PO1, PO3, PO4, PO6, PO8
CO4	Able to understand the techniques of biofertilizers	PO1, PO3, PO4, PO6, PO8
CO5	To know the technique of Single cell protein Cultivation	PO1, PO3, PO4, PO5, PO6, PO8

Unit	Details	No. of Hours
1	Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations – Successful Entrepreneur – Creativity, Leadership, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC).	15
2	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
3	Biogas as an alternative energy source. Biogas utilization. Biogas burners. Design of biogas burners. Stove models. Lighting mantles. Biogas using stationary power plants. Mobile power plants. Pollution control through anaerobic digestion.	15
4	Biofertilizer production: Nutritional value and composition of Azolla species. Growth requirements and mass cultivations of azolla, Media composition Azolla growth, Azolla production in small and large scale, harvesting and marketing.	15
5	Single Cell Protein Production: Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: SPIRULINA Cultivation – Processing, Experimental design; harvesting and Marketing.	15
Total		75

Text Books

- ❖ Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
- ❖ Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.
- ❖ The Earthworm book, Ismail, S.A., other India Press, Goa
- ❖ An Introduction to sericulture by G.Ganga, J.Sulochana Chetty.
- ❖ Silk: Processing, Properties and Applications Book by K. Murugesh Babu

Reference Books

- ❖ Adams, D. J., & Sparrow, J. C. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
- ❖ Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
- ❖ Desai, V. The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
- ❖ The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Russell
- ❖ Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava

Web Resources

- ❖ <https://archive.india.gov.in/citizen/agriculture>
- ❖ <http://www.recirculatingfarms.org/resources/>
- ❖ <https://academy.vertical-farming.net/intro-to-mushroom-growing/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	3	1	3	1	0	0	2	2	3	2	2	2
CO2	3	3	3	3	2	2	1	0	1	3	2	3	3	2	2
CO3	3	0	2	2	1	2	0	3	0	1	3	2	2	3	2
CO4	3	0	2	2	2	3	0	3	0	1	3	2	2	3	3
CO5	3	0	2	2	2	3	0	3	0	1	3	2	3	3	3
Total	15	5	11	12	8	13	2	9	1	8	13	12	12	13	12
Average	3.0	1.0	2.2	2.4	1.6	2.6	0.4	1.8	0.2	1.6	2.6	2.4	2.4	2.6	2.4

Course Coordinator

BOS Chairman

Core Paper XI - ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBT11	Core-XI	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Know about the environment, its issues and management of the environment.
- ❖ Explain the process of waste water treatment, drinking water treatment and solid waste management in various industries.
- ❖ Illustrate the significance of bioreactors in bioprocess engineering and culture methods.
- ❖ Explain Downstream processing, Fermented Products production and advanced methods
- ❖ Speculate the role and importance of microorganisms behind the ore leaching, production of food products and Biofertilizers.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Studying the impact of environmental pollution and its remediation measures.	PO1, PO3, PO4, PO6, PO8
CO2	Getting sound knowledge for waste water treatment	PO1, PO3, PO4, PO6, PO8
CO3	To understand the bioprocess engineering, basic techniques, methods and functions.	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	To understand the selective methods to purify the fraction to develop as commercial purpose	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	To understand the various techniques for isolation, recovery and purification of a protein and evaluate the outcome.	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
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.	15
2	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, and Textile) and Pesticide waste disposal.	15
3	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: Photo bioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenters. Fermentation systems Batch culture, Continuous culture, Fed-batch culture.	15
4	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. Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips -Types and applications. Microbial Polysaccharide production: Xanthan, Dextran.	15
5	Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - streptomycin. Alcoholic beverages: Wine, Beer –Biofertilizers- Rhizobium & Azotobacter. Biopesticides – <i>Bacillus thuringiensis</i> and microbial toxin production and their applications -Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids.	15
Total		75

Text Books

- ❖ Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi.
- ❖ Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International, New Delhi.
- ❖ Murugesan, A G., Rajakumari, C., 2005. Environmental Science and Biotechnology Theory and

Techniques., MJP publishers, Chennai.

- ❖ T.Satyanarayana, Bhavdish Narain Johri, Anil Prakash (2012), Microorganisms in Sustainable Agriculture and Biotechnology.
- ❖ Madigan, Michael and Martinko, John, Brock biology of microorganism, 11th edition, (2005).

Reference Books

- ❖ Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,
- ❖ Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, Elsevier Science Ltd
- ❖ Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higon (2001.), Industrial Microbiology: An Introduction. . Blackwell Science Ltd
- ❖ Nduka Okafor, Modern Industrial Biotechnology & Microbiology ()7102, Science Publishers, Edenbridge Ltd.
- ❖ Waites, Morgan, Rockey and Higon, Industrial Microbiology: An Introduction, Blackwell Science (2001).

Web Resources

- ❖ <https://nptel.ac.in/courses/120/108/120108004/>
- ❖ <https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf>
- ❖ [www. Prenhall.com/Madigan](http://www.Prenhall.com/Madigan)
- ❖ www.e-bug.eu/
- ❖ www.microbeworld.org/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME-SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	2	0	3	0	3	1	0	3	2	2	3	2
CO2	3	0	2	3	0	3	0	3	0	0	3	2	2	3	2
CO3	3	0	3	3	2	3	0	3	0	2	3	3	3	3	2
CO4	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
CO5	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
Total	15	0	13	14	8	15	0	15	1	6	15	13	13	15	12
Average	3.0	0.0	2.6	2.8	1.6	3.0	0.0	3.0	0.2	1.2	3.0	2.6	2.6	3.0	2.4

Course Coordinator

BOS Chairman

Core Paper XII – STEM CELL TECHNOLOGY AND TISSUE ENGINEERING

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBT12	Core-XII	Theory	Y	Y	-	4	3

Learning Objective

- ❖ To provide students with knowledge of wide ranging topics related to stem cells, regenerative medicine and tissue engineering.
- ❖ To offer the student state of the art education of pluripotent and multipotent cells
- ❖ To offer the students to know to how the pluripotent and multipotent cells can be used to treat the neurodegenerative disorders, cardiovascular disorders and diabetes.
- ❖ To review the current scenario of tissue engineering applications in bioartificial organs development and transplantation.
- ❖ To learn application of tissue engineering

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Gain fundamental knowledge in stem cell biology and tissue engineering	PO1, PO3, PO6, PO8
CO2	Describe sources, selection, potential manipulations and challenges of using stem cells for tissue engineering	PO1, PO3, PO4, PO5, PO6, PO8
CO3	Explain significance, current status and future potential of tissue engineering.	PO1, PO2, PO3, PO6, PO8, PO10
CO4	Identify key challenges in tissue engineering of different human tissues.	PO1, PO3, PO4, PO5, PO6, PO8
CO5	Describe design, fabrication and biomaterials selection criteria for tissue engineering scaffolds	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	Introduction to Stem cells -Introduction to Stem Cells – Definition, Classification, characteristics; Stem cell Vs Somatic cells; Differentiation, dedifferentiation and trans differentiation. Basics of animal cells/stem cells culture; Isolation, expansion, genetic manipulation, genetic reprogramming, and cloning of Stem cells. Cells cryopreservation.	12
2	Types of Stem Cells – Embryonic stem cells, Embryonic Germ cells; Stem cell Niche. Adult Stem Cells: hematopoietic stem cells, neural stem cells, muscle and cardiac stem cells, umbilical cord blood stem cells, cancer stem cells, mesenchymal stem cells, induced pluripotent Stem cells	12
3	Stem Cell Therapy: stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, Stem cell therapy for kidney failure, liver failure, infertility and cancer. Stem cell banking. Current status of Stem cell research. National and International guidelines and Ethics for stem cell research.	12
4	Introduction to Tissue Engineering, Biomaterials and Scaffolds: Basics and Principles of Tissue Engineering – History, importance and scope, Tissue dynamics/homeostasis. Tissue Engineering triangle, Role of growth factors, Biomaterials and Scaffolds in Tissue Engineering. Properties and types of scaffolds, tissue specific scaffolds; Methods of scaffold design preparation.	12
5	Tissue Engineering Applications -Tissue and organ transplantation. Bio- artificial organs: Skin, Liver, Bladder reconstruction, Kidney, Muscle, Neural, Bone and cartilage, and Cardiovascular tissue engineering. Commercial products from tissue engineering.	12
Total		60

Text Books

- ❖ Ed. Robert Lanza et al.; Principles of Tissue Engineering – 5 th Edition (2020); Academic Press
- ❖ 2 Lanza R., Atala A.; Essentials of Stem Cell Biology 3rd Edition (2013); Academic Press

Reference Books

- ❖ Boer J D et al.; Tissue Engineering – 2 nd Edition (2014); Academic Press
- ❖ Pallua N, Suschek CV; Tissue Engineering: from Lab to Clinic (2011); Springer
- ❖ Barnes SJ, Harris LP; Tissue Engineering: Roles, Materials and Applications – 1 st Edition (2008); Nova Science Publishers Inc
- ❖ Minuth WW, Strehl R, Schumacher K; Tissue Engineering: from Cell Biology to Artificial Organs (2017); Wiley VCH
- ❖ Knoepfler; Stem Cells: An Insider's Guide (2013); World Scientific Publishing Company

Web Resources

- ❖ <https://nptel.ac.in/courses/102/106/102106036/>
- ❖ <https://www.classcentral.com/course/stem-cells-10745>
- ❖ <https://research.pasteur.fr/en/course/mooc-advances-in-stem-cell-biology/>
- ❖ <http://ecoursesonline.iasri.res.in/course/view.php?id=73>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO2	3	0	3	2	2	3	0	3	0	0	3	3	2	3	2
CO3	3	2	2	0	0	2	0	2	0	2	3	2	1	2	2
CO4	3	0	3	3	2	3	0	3	0	0	3	3	3	3	2
CO5	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
Total	15	2	13	8	7	13	0	13	0	4	15	13	10	13	10
Average	3.0	0.4	2.6	1.6	1.4	2.6	0.0	2.6	0.0	0.8	3.0	2.6	2.0	2.6	2.0

Course Coordinator

BOS Chairman

CORE PRACTICAL VII - ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTP07	Core Practical VII	Practical	-	-	Y	4	3

Learning Objective

- ❖ Students can able to isolate the microorganisms and determine their growth curve, generation time.
- ❖ To analyze the water samples, perform immobilization and production of Wine, Biogas and compost.
- ❖ Develop skills in bio fertilizer production and microbial identification.
- ❖ Gain basic skills to analyze raw milk and determine the pasteurization efficacy.
- ❖ Develop skills to perform efficiency tests of biofertilizers and biopesticides, microbial polysaccharide production.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Demonstrate techniques for isolation, cultivation and identification of microorganisms from air, water, milk and fermented products.	PO1, PO3, PO4, PO6, PO8, PO10
CO2	Analyze microbial growth kinetics, generation time and assess microbial quality of environmental and food samples.	PO1, PO3, PO5, PO6, PO8, PO10
CO3	Apply biotechnological techniques for immobilization of cells/enzymes and production of fermented products such as wine and biogas.	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO10
CO4	Evaluate environmental biotechnology applications including wastewater analysis, composting, biofertilizer and Spirulina production.	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
CO5	Perform quality control tests in dairy products and interpret the results of milk grading and pasteurization efficiency.	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	1. Isolation of Air and Water Borne Bacteria 2. Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.	15
2	3. Water analysis – MPN and BOD. 4. Immobilization of whole yeast cells/ enzyme by Alginate beads. 5. Production of wine and estimation of alcohol 6. Production of Biogas – <i>In vitro</i> & Compost Making.	15
3	7. Biofertilizer production/Spirulina production - field visit. (Report should be included in the record) 8. Isolation of starter organisms from Idli batter/ curd	15
4	9. Grading of raw milk (Dye reduction test, MBRT test). 10. Determination of efficiency of Pasteurization by quantitative phosphatase test.	15
Total		60

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**

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	3	1	3	1	2	0	2	3	2	2	3	2
CO2	3	0	3	2	3	3	0	3	0	2	3	3	2	3	2
CO3	3	0	2	3	2	3	1	3	0	2	3	2	3	3	3
CO4	3	0	3	3	2	3	1	3	1	2	3	3	3	3	3
CO5	3	0	2	3	2	3	0	2	0	2	3	2	2	3	2
Total	15	0	12	14	10	15	3	13	1	10	15	12	12	15	12
Average	3.0	0.0	2.4	2.8	2.0	3.0	0.6	2.6	0.2	2.0	3.0	2.4	2.4	3.0	2.4

Course Coordinator

BOS Chairman

Elective VII - MARINE SCIENCE AND TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE11	ELE-VII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Students will gain knowledge about Marine Ecosystem and Resources.
- ❖ Will learn about bioactive compounds from Marine sources
- ❖ Will learn about medicinal seaweeds
- ❖ Will know about culture of seaweeds and Aquaculture
- ❖ Will know about Marine biotech products

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
C01	Explain important features of microbial diversity with reference to different niches in Oceans.	PO1, PO3, PO6, PO8
C02	To know about the microbial habitats	PO1, PO3, PO6, PO8
C03	To understand the medicinal compounds from flora and fauna	PO1, PO3, PO4, PO5, PO6, PO8
C04	Explain fundamental principles of aquaculture	PO1, PO3, PO4, PO6, PO8
C05	Know about important marine sources for valuable products.	PO1, PO3, PO4, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
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
2	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
3	Marine bioactive compounds from flora (Seaweeds, Seagrass and Mangro and fauna (Sponges, Sea anemone and Corals) - marine toxins- antiviral and antimicrobial agents. Cyanobacteria.	15
4	Culture aspect-Seaweed (<i>Kappaphycus alvarezii</i>), Marine aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Trangenesis.	15
5	Marine Products - Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin. Fish Preservation	15
Total		75

Text Books

- ❖ Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
- ❖ Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
- ❖ Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.
- ❖ David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
- ❖ Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience

Reference Books

- ❖ Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
- ❖ Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
- ❖ Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
- ❖ Gloria Sanchez, Elizabeth Hernandez,(2019), Environmental Biotechnology and cleaner Bioprocess, (1st edition), CRC Press, ISBN 9780367455552
- ❖ Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3rdedition), Wiley –

Blackwell.

Web Resources

- ❖ <http://coe.genomics.org.cn/>
- ❖ <http://www.bcb.iastate.edu/>
- ❖ <http://www.nwfsc.noaa.gov/protocols/bioinformatics.html>
- ❖ [http://www.ebi.ac.uk/ ExPASy.org/](http://www.ebi.ac.uk/ExPASy.org/)
- ❖ <http://www.expasy.org/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO2	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO3	3	0	3	2	2	3	0	3	0	0	3	3	2	3	2
CO4	3	0	2	2	0	2	0	2	0	0	3	2	1	2	2
CO5	3	0	3	2	2	3	0	3	0	2	3	3	2	3	3
Total	15	0	12	6	4	12	0	12	0	2	15	12	7	12	9
Average	3.0	0.0	2.4	1.2	0.8	2.4	0.0	2.4	0.0	0.4	3.0	2.4	1.4	2.4	1.8

Course Coordinator

BOS Chairman

Elective VII- FOOD SCIENCE AND TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE12	ELE-VII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Students will be able to understand the basic concepts of the food industry
- ❖ Will learn about classification of food
- ❖ Will learn about fruits, vegetables and horticulture
- ❖ Will learn about Non vegetarian food
- ❖ Will learn about food adulteration and biosensors to detect them

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	To understand the basic concepts of the food industry	PO1, PO2, PO3, PO8
CO2	Understand basic composition & structure of food grain	PO1, PO3, PO6, PO8
CO3	Developments and current status of fruits and vegetables storage and processing	PO1, PO3, PO4, PO5, PO6, PO8
CO4	Understand the compositional and technological aspects of meat, milk, and fish	PO1, PO3, PO4, PO5, PO6, PO8
CO5	To understand the type of adulterants	PO1, PO3, PO4, PO5, PO8, PO10

Unit	Details	No. of Hours
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 solid waste treatment of food industries. Historical evolution of food processing technology.	15
2	Cereals and Millets. Wheat- composition, types (hard, soft/ strong, weak). Malting, gelatinization of starch, types of browning- Maillard & caramelization. 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. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.	15
3	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, chemical, pathological changes during the storage of fruits and vegetables.	15
4	Red meat and white meat, composition of meat, marbling, and post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. Composition and nutritive value of egg, characteristics of fresh egg, deterioration of egg quality. Storage of meat and egg. Preservation of milk products.	15
5	Food adulterants – test to detect adulterants in foods – metal contaminants - contaminants of processed foods- Food products as analytical samples, general aspects of bioindicators- biosensors for food contaminant analysis, commercially available biosensors for food analysis. Food additives, FSSAI regulations, Methods of fortifying and enriching foods.	15
Total		75

Text Books

- ❖ Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013.
- ❖ B. Srilakshmi, Food science, New Age Publishers, 2002
- ❖ Joshi, V.K. and Singh, R.S., A. (2013), Food Biotechnology- Principles and practices,
- ❖ I.K. International Publishing House Pvt. Ltd., New Delhi,.
- ❖ Ravishankar Rai, V, (2015), Advances in Food Biotechnology, (First edition), John Wiley & Sons, Inc, ISBN 9781118864555.
- ❖ Perry Johnson-Green. (2018), Introduction to Food Biotechnology, Special Indian Edition,
- ❖ CRC Press, ISBN 9781315275703.

Reference Books

- ❖ Roday,S. Food Science, Oxford publication, 2011.
- ❖ Meyer, Food Chemistry, New Age,2004 5. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007
- ❖ Foster, G.N., (2020), Food Biotechnology, (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348.
- ❖ Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin(2005), Food Biotechnology, (2nd edition), CRC Press,ISBN 9780824753290.
- ❖ Roday,S. Food Science, Oxford publication, 2011.

Web Resources

- ❖ <https://ifst.onlinelibrary.wiley.com/journal/13652621>
- ❖ https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27
- ❖ <https://www.springer.com/journal/13197>
- ❖ <https://www.sciencedirect.com/referencework/9780081005965/food-science>
- ❖ <https://www.ift.org/news-and-publications/food-technology-magazine>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	2	2	0	0	0	0	2	0	0	3	2	1	2	1
CO2	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO3	3	0	3	2	2	2	0	3	0	0	3	3	2	3	2
CO4	3	0	3	2	2	2	0	3	0	0	3	3	2	3	2
CO5	3	0	3	2	2	0	0	3	0	2	3	2	2	3	2
Total	15	2	13	6	6	6	0	13	0	2	15	12	8	13	8
Average	3.0	0.4	2.6	1.2	1.2	1.2	0.0	2.6	0.0	0.4	3.0	2.4	1.6	2.6	1.6

Course Coordinator

BOS Chairman

Elective VII - CANCER BIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE13	ELE-VII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ The students will understand the Basics of Cancer Biology.
- ❖ The students will comprehend the Cancer at the Molecular level.
- ❖ The students will learn about the types of Cancer.
- ❖ The students will realize the different techniques of Detection and Treatment of Cancer.
- ❖ The students will know about the Prevention of Cancer.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand basic aspects of cancer	PO1, PO3, PO6, PO8
CO2	The role gene mutations play in the development of cancer	PO1, PO3, PO5, PO6, PO8
CO3	To know the types of cancer	PO1, PO3, PO6, PO8
CO4	To learn the technologies and methods used to detect and treatment of cancer	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	To understand the preventive measures	PO1, PO2, PO3, PO4, PO8, PO9

Unit	Details	No. of Hours
1	Introduction; Origin of Cancer- Mutations that cause changes in signal molecules, effects on receptor, signal switches, Apoptosis, Development and causes of cancer. Difference between Normal and Cancer cells; Signs and symptoms.	15
2	Principles of cancer metastasis: Clinical significances of invasion, Heterogeneity of metastatic phenotype, three step theory of invasion, Proteinases and tumor cell invasion.	15
3	Types of Cancer: – Leukemia, Malignant lymphoma, Bone-Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumor suppressor genes and its classification.	15
4	Cancer therapy: Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection. Detection and Treatment: - Early detection, Molecular detection of Carcinomas, cancer Markers (PSA) in blood.	15
5	Causative agents: - Tobacco, sunlight, diet, ionizing radiation, alcohol, drugs. Environmental factors and carcinogenic substances. Life style and cancer prevention.	15
Total		75

Text Books

- ❖ A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
- ❖ Ranajit Sen, 2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.
- ❖ Dr M.R. Ahuja, 1997, Cancer- Causes and Prevention, UBS Publishers Distributors Pvt. Ltd.
- ❖ A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
- ❖ Ranajit Sen, 2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.

Reference Books

- ❖ Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
- ❖ Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.
- ❖ Robin Hesketh, 2012, Introduction to Cancer Biology, Cambridge University Press
- ❖ Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
- ❖ Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.

Web Resources

- ❖ <http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf>
- ❖ <http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME



	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO2	3	0	3	0	2	2	0	3	0	0	3	3	2	3	2
CO3	3	0	2	0	0	2	0	2	0	0	3	2	1	2	1
CO4	3	0	3	3	3	3	0	3	0	2	3	3	3	3	3
CO5	3	2	2	2	0	0	0	2	2	0	2	2	1	2	2
Total	15	2	12	5	5	9	0	12	2	2	14	12	8	12	9
Average	3.0	0.4	2.4	1.0	1.0	1.8	0.0	2.4	0.4	0.4	2.8	2.4	1.6	2.4	1.8

Course Coordinator

BOS Chairman

ELECTIVE VIII - MEDICAL BIOTECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE14	ELE-VIII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Student will be able to obtain knowledge on Vaccines, Antibody therapy and diagnostics
- ❖ Will know the Molecular basis of diseases
- ❖ Will know about cytokines and interferons
- ❖ Will learn about clinical trials
- ❖ Will learn about ethics in clinical trials

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand broad theoretical knowledge and critical understanding of advanced principles in antibodies and vaccines	PO1, PO3, PO5, PO8
CO2	Gain the practical knowledge required to support a career in biomedical research environment	PO1, PO4, PO6, PO7, PO8, PO10
CO3	Gain the knowledge about the diagnostics of infectious diseases	PO1, PO3, PO4, PO5, PO6, PO8
CO4	Have a sound platform for setting up basic therapeutical production	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO5	Gain the knowledge about clinical trials and applications	PO1, PO2, PO3, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
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
2	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
3	Diagnosis of infectious diseases, Viral diseases – HIV, influenza; bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays. FACs immune histo chemical staining, ELISA, FISH techniques.	15
4	Immunoblot analysis of antigens and allergens. – Productions and application of therapeutic agents, Production of cytokines and interferons.	15
5	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.	15
Total		75

Text Books

- ❖ Roli, M. (2017). National Ethical Guidelines for Biomedical and Health Research Involving Human Participants, ISBN: 978-81-910091-94
- ❖ 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
- ❖ Clinical Applications, (1st Edition). Philadelphia, USA. F A Davis Company. ISBN- 13: 978-0803626775

Reference Books

- ❖ Bernard, R. G. Terry, L.D. and Cheryl, L.P. (2014). Medical Biotechnology, (2nd edition).

- ❖ Patrick, R.M. Kenneth, S.R. and Michael, A.P. (2016). Medical Microbiology, (8th edition). USA. Elsevier Publishers, eBook ISBN: 9780323388504
- ❖ Pamela, G. Michelle, M, (2009). Molecular Therapeutics: 21st century medicine, (1st Edition). Hoboken, New Jersey. Wiley Publishers.

Web Resources

- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/>
- ❖ <https://www.nature.com/articles/s41577-021-00542-x>
- ❖ <https://www.ncbi.nlm.nih.gov/books/NBK26837/>
- ❖ <https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing>
- ❖ <http://aquafind.com/articles/Elisa.php>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	3	0	2	0	0	3	0	0	3	3	1	3	2
CO2	3	0	0	3	0	3	2	2	0	2	3	2	2	3	3
CO3	3	0	2	2	2	3	0	3	0	0	3	3	2	3	2
CO4	3	0	3	3	2	3	0	3	0	2	3	3	3	3	3
CO5	3	2	2	0	2	2	0	2	0	2	2	3	2	2	3
Total	15	2	10	8	8	11	2	13	0	6	14	14	10	14	13
Average	3.0	0.4	2.0	1.6	1.6	2.2	0.4	2.6	0.0	1.2	2.8	2.8	2.0	2.8	2.6

Course Coordinator

BOS Chairman

ELECTIVE VIII- FORENSIC SCIENCE AND TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE15	ELE-VIII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ Students will gain insight into Forensic Biotechnology.
- ❖ Will know about various investigations protocol
- ❖ Will know about blood related issues
- ❖ Will know the use of molecular approaches to investigation
- ❖ Will understand DNA fingerprinting

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	The student will be able to describe the fundamental principles and functions of forensic science and its significance to human society.	PO1, PO2, PO3, PO8, PO9
CO2	The student will be able to demonstrate the art of collecting, packaging, and preserving different types of physical and trace evidence at crime scenes, and the legal importance of chain of custody.	PO1, PO4, PO5, PO6, PO7, PO8
CO3	to justify the importance of biological fluids – blood, urine, semen, saliva, sweat, and milk – in crime investigations	PO1, PO3, PO4, PO5, PO6, PO8
CO4	The student will be able to explain the basic principle of DNA analysis and forensic significance of DNA typing	PO1, PO3, PO5, PO6, PO8, PO10
CO5	The student will be able to describe the importance of restriction fragment length polymorphism in DNA technique	PO1, PO3, PO5, PO6, PO8, PO10

Unit	Details	No. of Hours
1	Scope of Forensic Biotechnology, History and development, Forensic genetics, Forensic agriculture.	15
2	Crime scene investigation; collection, preservation, packing and forwarding of physical and trace evidence. Biological Evidence: Nature, collection, identification, evaluation of hair and fibres. Questioned documents – identification of handwriting, signature and detection of forgery. Forensic Art Illustration: Introduction, Finding and identifying human face image. Post mortem drawing, methods of superimposition.	15
3	Definition and Classification of fingerprints (Henry system). Taking fingerprints from living and dead persons. Automatic fingerprint identification system (AFIS). Serology - Fresh blood grouping and typing. Identification of blood stains, collection and storage of allied body fluids (semen, saliva and blood). Case studies.	15
4	Fatality Forensics: Introduction, cause, manner and characteristics of death, Road traffic fatality (RTF) investigation. General classification of RTFs.	15
5	DNA Fingerprinting (DFP) technology: An overview, Applications of DFP in forensic investigations, paternity disputes. DNA Profiling practice in India with reference to criminal cases.	15
Total		75

Text Books

- ❖ Nageshkumar G Rao, Textbook of Forensic Medicine & Toxicology, Jaypee, 2013.
- ❖ K.S. Narayan reddy and O.P. Murty, The Essentials of Forensic Medicine & Toxicology, 35th Edition, Jaypee, 2017.
- ❖ 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.
- ❖ Barbara H. Stuart (2013). Forensic Analytical Techniques (Analytical Techniques in the Sciences (AnTs), (1st edition), UK, Wiley, ISBN: 978-0-470-68727-7.
- ❖ C. Champod, C. Lennard, C. Margot, P. and Stoilovic (2015). Fingerprints and other Ridge Skin Impressions, (7th edition), Boca Raton, CRC Press, ISBN: 9781498728959.

Reference Books

- ❖ Jim Fraser, " Forensic Science: A very short introduction", Oxford university press, 2010.
- ❖ William Goodwin, Adrian Linacre, SibteHadi, "An introduction to Forensic Genetics", John Wiley & Sons Ltd 2007.
- ❖ Harralson H. and Miller S. (2017). Huber and Headrick's Handwriting Identification: Facts and Fundamentals, (2nd Edition), Boca Raton, CRC Press, ISBN: 9781498751308.
- ❖ Ghosal S. and Avasthi A.S. (2018). Fundamentals of Bioanalytical Techniques and Instrumentation (2nd Edition), Delhi, PHI, ISBN: 9789387472396.

Web Resources

- ❖ <http://www.forensicsciencesimplified.org>
- ❖ www.nfstc.org
- ❖ https://archive.org/details/FBI_Handbook_of_ForensicScience
- ❖ <https://www.soinc.org/forensics-notes>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	1	1	2	-	2	1	2	-	1	3	1	1	2	2
CO2	3	1	2	2	1	2	-	2	-	1	3	2	1	2	2
CO3	3	1	2	3	2	3	1	3	-	2	3	2	3	3	2
CO4	3	1	3	3	3	3	1	3	-	2	3	3	3	3	3
CO5	3	2	3	3	3	3	1	3	1	2	3	3	3	3	3
Total	15	6	11	13	9	13	4	13	1	8	15	11	11	13	12
Average	3.0	1.2	2.2	2.6	1.8	2.6	0.8	2.6	0.2	1.6	3.0	2.2	2.2	2.6	2.4

Course Coordinator

BOS Chairman

Elective VIII -GOOD LABORATORY PRACTICES (GLP)

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTE16	ELE-VIII	Theory	Y	Y	-	5	3

Learning Objective

- ❖ The student will know the types of labs associated with Biotechnology
- ❖ Will know to use and maintain lab Instruments
- ❖ Will know the calculations needed in a laboratory
- ❖ Will know about good lab Guidelines
- ❖ Will know how to safely dispose bio waste

Course Outcome

- ❖ To learn about the types of lab associated with biotechnology
- ❖ To learn the basics of instrumentation
- ❖ To know the calculations
- ❖ To learn the operating guidelines
- ❖ To know the disposal of biological and chemical wastes

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Understand the different types of laboratories associated with biotechnology and their functions.	PO1, PO4, PO6, PO7, PO8, PO9, PO10
CO2	Understand the basic principles and applications of instruments used in biotechnology laboratories.	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO10
CO3	Apply mathematical and numerical calculations relevant to biotechnology laboratory procedures.	PO1, PO3, PO4, PO5, PO6, PO8, PO10
CO4	Demonstrate knowledge of operating guidelines, laboratory safety procedures and proper handling of laboratory instruments.	PO1, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
CO5	Understand and apply appropriate methods for the segregation, treatment and disposal of biological and chemical wastes.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10

Unit	Details	No. of Hours
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
2	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
3	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
4	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
5	Definition of waste, types of waste: Biological and chemical 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

- ❖ WHO training manual on Good Laboratory Practices, 2nd Edition.

Reference book

- ❖ Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.

Web Resources

- ❖ <https://www.who.int/tdr/publications/documents/glp-trainer.pdf>

- ❖ <https://www.who.int/tdr/publications/documents/glp-trainer.pdf>">publications › documents
- ❖ <https://www.who.int/tdr/publications/documents/glp-trainer.pdf>"glp
- ❖ <https://www.who.int/tdr/publications/documents/glp-trainer.pdf>"-trainer

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	1	2	0	2	2	2	1	2	3	2	1	2	1
CO2	3	0	2	2	1	2	1	2	0	3	3	2	2	3	2
CO3	3	0	3	3	3	2	0	3	0	2	3	3	3	3	1
CO4	3	0	2	3	2	3	2	3	1	3	3	3	2	3	2
CO5	3	1	3	3	2	3	2	3	2	2	3	3	3	3	3
Total	15	1	11	13	8	12	7	13	4	12	15	13	11	14	9
Average	3.0	0.2	2.2	2.6	1.6	2.4	1.4	2.6	0.8	2.4	3.0	2.6	2.2	2.8	1.8

Course Coordinator

BOS Chairman

PROFESSIONAL COMPETENCY SKILL ENHANCEMENT

SKILL BASED PAPER FOR COMPETITIVE EXAMINATION

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S6UBTS	SBC	Theory	Y	Y	-	2	2

Learning Objective

- ❖ To develop quantitative aptitude skills required for business and managerial decision making.
- ❖ To enhance logical and analytical thinking abilities
- ❖ To strengthen data interpretation and problem-solving competencies.
- ❖ To prepare students for competitive examinations, placement tests, and managerial aptitude assessments.

Course Outcomes		
Course Outcomes	On completion of this Course, Students will able to	Programme Outcomes
CO1	Apply numerical and arithmetic concepts to solve real life problems.	PO1, PO3, PO4, PO5, PO8
CO2	Analyze quantitative information involving percentages, profit and loss, interest, partnership, and financial calculations.	PO1, PO3, PO4, PO5, PO8
CO3	Derive calculations involved in simple compound interests.	PO1, PO3, PO4, PO5, PO8
CO4	Demonstrate problems on stocks, arrangement of numbers	PO1, PO3, PO4, PO5, PO8
CO5	Interpret and evaluate data presented in tables, charts, graphs	PO1, PO3, PO5, PO8, PO10

Unit	Details	No. of Hours
1	Numbers, HCF and LCM, Averages, Problems on numbers	6
2	Percentage, Profit and Loss, Ratio and Proportion	6
3	Simple Interest, Compound Interest, Partnership	6
4	Permutations and Combinations, Probability	6
5	Tabulation, Bar graphs, Pie Charts, Line Graph	6
Total		30

Text Books

- ❖ R.S. Aggarwal, *Quantitative Aptitude for Competitive Examinations*, S. Chand Publications.

References

- ❖ Arun Sharma, *How to Prepare for Quantitative Aptitude*, McGraw Hill.
- ❖ Abhijit Guha, *Quantitative Aptitude for Competitive Examinations*, McGraw Hill.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	POs										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CO1	3	0	3	3	2	0	0	2	0	0	3	3	3	2	1
CO2	3	0	3	3	3	0	0	2	0	0	3	3	3	3	1
CO3	3	0	3	3	3	0	0	2	0	0	3	3	3	3	1
CO4	3	0	3	3	2	0	0	2	0	0	3	3	3	2	1
CO5	3	0	3	3	3	0	0	3	0	2	3	3	3	3	2
Total	15	0	15	15	13	0	0	11	0	2	15	15	15	13	6
Average	3.0	0.0	3.0	3.0	2.6	0.0	0.0	2.2	0.0	0.4	3.0	3.0	3.0	2.6	1.2

Course Coordinator

BOS Chairman