THIRUVALLUVAR UNIVERSITY
SERKKADU, VELLORE–632115

B. Sc. BIOTECHNOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

CHOICE BASED CREDIT SYSTEM AND LEARNING OUTCOMES-BASED

CURRICULUM FRAMEWORK - B.Sc. Biotechnology	
Programme:	**B.Sc.** Biotechnology
Programme Code:	
Duration:	**3 Years (UG)**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate

	hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

	PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to: **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory. **PSO2: Critical Thinking:** Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively **PSO3: Problem Solving:** Employ theoretical concepts and critical 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 analyse 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.

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

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

2. Highlights of the Revamped Curriculum:

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

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT

		tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer

		group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honors degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	C	H	Sem II	C	H	Sem III	C	H	Sem IV	C	H	Sem V	C	H	Sem VI	C	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective - VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancem	2	2	2.7 Skill Enhancem	2	2	3.7 Skill Enhancemen	2	2	4.7 Skill Enhancem	2	2	5.7 Value Education	2	2	6.7 Professional	2	2

ent - (Foundation Course)			ent Course –SEC-3			t Course SEC-5			ent Course SEC-7						Competency Skill		
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**
Total – 140 Credits																	

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

Guideline Based Credit and Hours Distribution System

for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses& Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses& Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses& Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses& Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

Third Year

Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	26
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

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

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

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

FIRST SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language- Tamil Paper – I	6	3	25	75	100
Part - II	English Paper – I	6	3	25	75	100
Part III	Core Paper I - Cell and Molecular Developmental Biology	5	5	25	75	100
	Core paper II- Practical I - Cell and Molecular Developmental Biology	3	3	25	75	100
	Elective I, Generic / Discipline Specific – Biological Chemistry	4	3	25	75	100
	Elective I, Generic / Discipline Specific: Practical - Biological Chemistry	2	2	25	75	100
Part IV	Skill Enhancement (NME) - Public Health and Hygiene	2	2	25	75	100
	Skill Enhancement (Foundation Course) - Basics of Biotechnology	2	2	25	75	100
		30	**23**			

SECOND SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language- Tamil – II	6	3	25	75	100
Part - II	English Paper – II	6	3	25	75	100
Part - III	Core Paper III - Genetics	5	5	25	75	100
	Core Practical IV - Genetics	3	3	25	75	100
	Elective II, Generic / Discipline Specific – Fundamentals of Microbiology	4	3	25	75	100
	Elective II, Generic / Discipline Specific: Practical - Fundamentals of Microbiology	2	2	25	75	100
Part IV	Skill Enhancement (NME) - Organic Farming and Health Management	2	2	25	75	100
	Skill Enhancement (NME) - Vermitechnology	2	2	25	75	100
		30	**23**			

MANDATORY SUBJECTS

1) Cell and Molecular Developmental Biology
2) Biological Chemistry
3) Genetics
4) Fundamentals of Microbiology
5) Immunology and Immunotechnology
6) Bioinstrumentation
7) Genetic Engineering and rDNA Technology
8) Bioinformatics and Biostatistics
9) Plant Biotechnology
10) Animal Biotechnology
11) Environmental and Industrial Biotechnology
12) Nano Biotechnology
13) Enzymology
14) Bioethics and Biosafety
15) Cancer Biology
16) Bio entrepreneurship
17) Pharmaceutical Biotechnology
18) Marine Biotechnology
19) Food Technology
20) Forensic science
21) Good Laboratory Practices

FIRST YEAR - SEMESTER – I

CORE- I: CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

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

Learning Objective: On successful completion of the course, students will be able to		
LO1	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	
LO2	Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane.	
LO3	Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication,Transcription and Translation and post translational modifications of proteins.	
LO4	Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways.	
LO5	Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.	
UNIT	**Contents**	**No.of Hours**
I	Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).	10
II	Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.	20
III	Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications.	15
IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion – Extra Cellular Matrix	15

	- Cell to cell communications.	
V	Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.	15
Total		**75**
Text Books		
1	T. Devasena (2012), Cell Biology, Oxford University Press.	
2	Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.	
3	Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.	
4	Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton &Company.	
5	James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.	
Reference Books		
1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.	
2	James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications.	
3	Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press.	
4	Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.	
5	Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.	
Web Resources		
1	http://www.cellbiol.com/education.php	
2	https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/	
3	https://dnalc.cshl.edu/websites/	
4	https://www.cellsignal.com/contents/science/cst-pathways/science-pathways	
5	https://nptel.ac.in/courses/102/106/102106025/11.	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	3	2	1	3	-	3	3	2	3
CLO2	3	3	3	3	-	3	3	2	3
CLO3	3	3	3	2	-	3	3	2	2
CLO4	3	2	3	2	-	3	3	2	3
CLO5	3	3	2	2	-	3	3	2	3
TOTAL	**15**	**14**	**12**	**12**	**0**	**15**	**15**	**10**	**15**
AVERAGE	**3**	**2.8**	**2.4**	**2.4**	**0**	**3**	**3**	**2**	**3**

ELECTIVE PAPER I- BIOLOGICAL CHEMISTRY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	3	1			3	4	25	75	100

Learning Objective		
LO1	Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding.	
LO2	Demonstrates the formation of different types of solutions, concentrations of solution sand preparation of buffer solutions	
LO3	Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.	
LO4	Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.	
LO5	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.	
UNIT	**Contents**	**No.of Hours**
1	Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization.	10
II	Acids & Bases properties and differences - Concepts of acids and bases- Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer.	15
III	Importance to Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. Classification of carbohydrates. Properties of	15

	carbohydrates. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle.	
IV	Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. B-oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids - Salvage pathway.	10
V	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 and Hormones.	10
Total		60
Text Books		
1	P.L. Soni , A Text-book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications	
2	Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition	
3	J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.	
4	A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.	
5	Satyanarayana .U, 2016, Biochemistry, MJ publishers 3rd edition (2006).	
Reference Books		
1	Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY	
2	Murray *et al.,* (2003) Harper's biochemistry 26 th edition Appleton and Lange Publishers Florida USA	
3	Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.	
4	Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco	
5	Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications	
Web Resources		
1	http/dwb4.unl.edu/chem869p/chem869plinks/s	
2	www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp	

3	https://www.britannica.com › science › biochemistry
4	https://]ww.sciencedirect.com › topics › agricultural-and-biological-sciences
5	https://biochemistry.org › education › careers › becoming-a-bioscientist › w

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME

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

PRACTICAL - I CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

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

Learning Objective		
LO1	Demonstrate the operation of Light Microscope	
LO2	Identify blood cells and its components	
LO3	Isolate and identify plant, and animal cells.	
LO4	Summarizes the concept of gametes	
LO5	Develop skill to perform cell fractionations.	
UNIT	**Contents**	**No.of Hours**
I	Components of a Compound / Light Microscope.	9
II	Blood smear preparation and Identification of Blood cells. Buccal smear preparation and Identification of squamous epithelial cells.	9
III	Isolation and Identification of plant cells.	9
IV	Observation of sperm & Egg. Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.	9
V	Cell fractionation and Identification of cell organelles (Demo)	9
Total		**45**

Text Books

1 K.V. Chaitanya, (2013), *Cell and molecular biology*: Lab manual, PHI publishers,. ISBN 978-81-203-800-4

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	3	2	3	3	2	2
CLO2	3	3	3	3	3	3	3	2	2
CLO3	3	3	3	3	3	3	3	3	3
CLO4	3	2	3	3	3	3	3	3	3
CLO5	3	3	2	3	2	2	2	3	3
TOTAL	**15**	**14**	**14**	**15**	**13**	**14**	**14**	**13**	**13**
AVERAGE	**3**	**2.8**	**2.8**	**3**	**2,6**	**2.8**	**2.8**	**2.6**	**2.6**

ELECTIVE PRACTICAL I-BIOLOGICAL CHEMISTRY

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

Learning Objective	
LO1	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.
LO2	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.
LO3	Understand the methods of acidimetry, alkalimetry and permanganometry.
LO4	Quantify Ascorbic acid in lemon by Dichlorophenol indo phenol dye method, Glycine by sorensons formal titration method.
LO5	Estimate Glucose, Cholesterol and Proteins.

UNIT	Contents	No.of Hours
1	**Systematic analysis of Organic compounds** Functional group tests (Carboxylic acid, Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde.	7
II	**Qualitative Analysis** Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.	7
III	**Volumetric Analysis**: 1. Estimation of Glycine- Formal Titration. 2. Determination of Ascorbic acid – DCPIP method.	7
IV	Colorimetric Analysis 1.Estimation of Cholesterol- Zak's method 2.Estimation of proteins – Bradford's method	9
Total		**30**

Text Books	
1	J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2	S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005.
3	Irwin H.Segel, Biochemical calculations,Liss, Newyork,1991.
Reference Books	
1	Dr. O P Panday, D N Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016.
2	Hands Thacher Clarke, A hand book of Oraganic:Qualitative and quantitative Analysis, 2007.
3	N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S.Viswanathan Co. Pvt. Ltd., 1998.

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME

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

SKILL ENHANCEMENT COURSE – FOUNDATION COURSE

SEMESTER -I - BASICS OF BIOTECHNOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	2				2	2	25	75	100
Learning Objectives:									
LO1	The student can understand the basics of biotechnology.								
LO2	Able to explain the basic concept of biotechnology.								
LO3	Can differentiate various types of biotechnology.								
LO4	Can outline various biotech based products used in day to day life.								
LO5	Apply the concepts of biotechnology in various fields.								

Unit I: Introduction to Biotechnology – Definition – History of Biotechnology – Scope of Biotechnology –Advantages and Disadvantages of Biotechnology. **6 hrs**

Unit II: Basic concept of biotechnology (r – DNA technology) - Isolation of the DNA from the donor organism - DNA fragmentation using the restriction endonucleases - Ligation of the desired DNA fragment into the vector- Transfer of Recombinant DNA to the host - Culture of transformed cells in a nutrient medium - Extraction of the desired product. **6 hrs**

Unit III: Types of Biotechnology: Blue Biotechnology – Green Biotechnology – Red Biotechnology – White Biotechnology – Grey Biotechnology – Yellow Biotechnology – Gold Biotechnology – Black Biotechnology. **6 hrs**

Unit IV: Biotechnology in daily life – Dairy Products – Bakery Products –Beverages – Cosmetics – Detergents – Genetically Modified Crops – Antibiotics – Vaccines – Biofuels. **6 hrs**

Unit V: Applications of Biotechnology – Plant Biotechnology – Animal Biotechnology – Industrial Biotechnology – Medical Biotechnology – Herbal Biotechnology – Marine Biotechnology – Enzyme Technology. **6 hrs**

SKILL ENHANCEMENT COURSE – FOUNDATION COURSE

SEMESTER -I - PUBLIC HEALTH AND HYGIENE

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

Learning Objective	
LO1	can explain the importance of health and hygiene
LO2	can analyze the importance of food and malnutrition
LO3	can understand the cause of diseases
LO4	Will get know about lifestyle diseases
LO5	Will get awareness about various Health Services Organizations

UNIT	Contents	No. of Hours
1	Scope of health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Personal hygiene, oral hygiene and sex hygiene.	6
II	Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Rickets, Goiter (cause, symptoms, precaution and cure).	6
III	Communicable viral diseases (cause, symptoms, precaution and cure) - chicken pox, dengue, hepatitis and Covid 19. Communicable bacterial diseases- tuberculosis, typhoid, cholera, sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.	6
IV	Non-communicable diseases- hypertension, stroke, coronary heart disease, rheumatoid arthritis (cause, symptom, precautions). Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy), Mental	6

	illness(depression and anxiety). Oral and lung cancer and their preventive measures.	
V	Health Services Organizations: World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and Indian Red Cross (IRC).	6
Total		**30**
Text Books		
1	Mary Jane Schneider (2011) Introduction to Public Health.	
2	Muthu, V.K. (2014) A Short Book of Public Health.	
3	Detels, R. (2017) Oxford Textbook of Public Health (6th edition).	
4	Gibney, M.J. (2013) Public Health Nutrition.	
5	Wong, K.V. (2017) Nutrition, Health and Disease.	
Reference Books		
1	S. Lal, (2018), Vikas. *Public Health Management Principles And Practice*, 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.	
2	Mary-Jane Schneider (2016), *Introduction to Public Health*,(5th Edition), Jones & Bartlett Learning,. ISBN-13: 978-1284197594	
3	Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), *Handbook of Nutrition and Food*, (3rd Edition), CRC Press,. ISBN 9781466505711	
4	Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), *Principles of Occupational Health and Hygiene: An Introduction, (* 2nd Revised ed. Edition), Allen &Unwin,	
5	V. Kumaresan, R. Sorna Raj*, (*2012) *Public Health and Hygiene*,(1st Edition), Saras Publication.	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**-**	**2**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**-**	**2**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**
CLO5	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**3**
TOTAL	**14**	**15**	**4**	**11**	**15**	**15**	**14**	**14**	**15**
Average	**2.8**	**3**	**0.8**	**2.2**	**3**	**3**	**2.8**	**2.8**	**3**