

# **B.Sc., BIOTECHONOLOGY**

## **SYLLABUS**

**FROM THE ACADEMIC YEAR  
2023 - 2024**

**TAMILNADU STATE COUNCIL FOR HIGHER  
EDUCATION, CHENNAI – 600 005**

**CHOICE BASED CREDIT SYSTEM AND LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK - B.Sc. Biotechnology**

<b>Programme:</b>	B.Sc. Biotechnology
<b>Programme Code:</b>	
<b>Duration:</b>	3 Years (UG)
<b>Programme Outcomes:</b>	<p><b>PO1: Disciplinary knowledge:</b> Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p><b>PO2: Communication Skills:</b> 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.</p> <p><b>PO3: Critical thinking:</b> 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.</p> <p><b>PO4: Problem solving: Capacity</b> 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.</p> <p><b>PO5: Analytical reasoning:</b> 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.</p> <p><b>PO6: Research-related skills:</b> 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</p> <p><b>PO7: Cooperation/Team work:</b> 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</p> <p><b>PO8: Scientific reasoning:</b> Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences</p>

	<p>from an open-minded and reasoned perspective.</p> <p><b>PO9: Reflective thinking:</b> Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.</p> <p><b>PO10 Information/digital literacy:</b> 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.</p> <p><b>PO 11 Self-directed learning:</b> Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p><b>PO 12 Multicultural competence:</b> 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.</p> <p><b>PO 13: Moral and ethical awareness/reasoning:</b> Ability to embrace 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 demonstrating the 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.</p> <p><b>PO 14: Leadership readiness/qualities:</b> 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.</p> <p><b>PO 15: Lifelong learning:</b> 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.</p>
<p><b>Programme Specific Outcomes:</b></p>	<p>On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to:</p> <p><b>PSO1: Disciplinary Knowledge:</b> Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory.</p> <p><b>PSO2: Critical Thinking:</b> Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively</p> <p><b>PSO3: Problem Solving:</b> Employ theoretical concepts and critical reasoning</p>

	<p>ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.</p> <p><b>PSO4: Analytical &amp; Scientific Reasoning:</b> Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models.</p> <p><b>PSO5: Research related skills:</b> Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.</p> <p><b>PSO6: Self-directed &amp; Lifelong Learning:</b> 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.</p>
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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:**

<b>Semester</b>	<b>Newly introduced Components</b>	<b>Outcome / Benefits</b>
<b>I</b>	<p><b>Foundation Course</b> 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.</p>	<ul style="list-style-type: none"> <li>• Instil confidence among students</li> <li>• Create interest for the subject</li> </ul>
<b>I, II, III, IV</b>	<p><b>Skill Enhancement papers</b> (Discipline centric / Generic / Entrepreneurial)</p>	<ul style="list-style-type: none"> <li>• Industry ready graduates</li> <li>• Skilled human resource</li> <li>• Students are equipped with essential skills to make them employable</li> <li>• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects</li> <li>• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.</li> <li>• Entrepreneurial skill training will provide an opportunity for independent livelihood</li> <li>• Generates self – employment</li> <li>• Create small scale entrepreneurs</li> <li>• Training to girls leads to women empowerment</li> <li>• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools</li> </ul>
<b>III, IV, V &amp; VI</b>	<p>Elective papers- An open choice of topics categorized under Generic and Discipline Centric</p>	<ul style="list-style-type: none"> <li>• Strengthening the domain knowledge</li> <li>• Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature</li> <li>• Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background</li> </ul>

		<ul style="list-style-type: none"> <li>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</li> </ul>
<b>IV</b>	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	<ul style="list-style-type: none"> <li>Exposure to industry moulds students into solution providers</li> <li>Generates Industry ready graduates</li> <li>Employment opportunities enhanced</li> </ul>
<b>II year Vacation activity</b>	Internship / Industrial Training	<ul style="list-style-type: none"> <li>Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.</li> </ul>
<b>V Semester</b>	Project with Viva – voce	<ul style="list-style-type: none"> <li>Self-learning is enhanced</li> <li>Application of the concept to real situation is conceived resulting in tangible outcome</li> </ul>
<b>VI Semester</b>	Introduction of Professional Competency component	<ul style="list-style-type: none"> <li>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;</li> <li>‘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.</li> </ul>
<b>Extra Credits: For Advanced Learners / Honors degree</b>		<ul style="list-style-type: none"> <li>To cater to the needs of peer learners / research aspirants</li> </ul>
<b>Skills acquired from the Courses</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

### Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	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 Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	<b>23</b>	<b>30</b>		<b>23</b>	<b>30</b>		<b>22</b>	<b>30</b>		<b>25</b>	<b>30</b>		<b>26</b>	<b>30</b>		<b>21</b>	<b>30</b>
<b>Total – 140 Credits</b>																	



**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**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
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
		<b>23</b>	<b>30</b>

**Semester-II**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
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
		<b>23</b>	<b>30</b>

**Second Year – Semester-III**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
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
		<b>22</b>	<b>30</b>

**Semester-IV**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
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
		<b>25</b>	<b>30</b>

**Third Year  
Semester-V**

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

**Semester-VI**

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

**Consolidated Semester wise and Component wise Credit distribution**

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

**\*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.**

**MethodsofEvaluation**

<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat 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 II Practical I - Cell and Molecular Developmental Biology	5	5	25	75	100
	Allied Paper I - Biological Chemistry	4	3	25	75	100
Part IV	Skill Enhancement-SEC:1- Mushroom Cultivation	2	2	25	75	100
	Foundation Course- Basics of Biotechnology	2	2	25	75	100
		<b>30</b>	<b>23</b>			

**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	5	5	25	75	100
	Elective II, Generic / Discipline Specific	4	3	25	75	100
Part IV	Skill Enhancement(SEC:2)- Vermitechnology	2	2	25	75	100
	Skill Enhancement(SEC:3)- Essential Oil Preparations	2	2	25	75	100
		<b>30</b>	<b>23</b>			

**THIRD SEMESTER**

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part – I	Language- Tamil III	6	3	25	75	100
Part - II	English Paper – III	6	3	25	75	100
Part - III	Core Paper V - Immunology and Immunotechnology	5	5	25	75	100
	Core Practical VI - Immunology and Immunotechnology	5	5	25	75	100
	Elective Paper III – Bioinstrumentation	4	3	25	75	100
PART IV	Soft Skills	1	1	25	75	100
	Soft Skills	2	2			
	• Environmental Studies	1	0	-	-	-
		<b>30</b>	<b>22</b>			

**FOURTH SEMESTER**

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part - I	Language- Tamil – IV	6	3	25	75	100
Part - II	English Paper – IV	6	3	25	75	100
Part - III	Core Paper VII – Genetic Engineering and rDNA Technology	5	5	25	75	100
	Core VIII Practical V - Genetic Engineering and rDNA Technology	5	5	25	75	100
	Elective Paper IV - Bioinformatics and Biostatistics	3	3	25	75	100
	Skill development Course (Preparation for Exams)	2	2	25	75	100
Part-IV	Skill development Course (Preparation for Exams)	2	2	25	75	100
	Environmental Studies	1	2	25	75	100
		<b>30</b>	<b>25</b>			

### FIFTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part - III	Core Paper IX – Plant Biotechnology	5	4	25	75	100
	Core Paper X - Animal Biotechnology	5	4	25	75	100
	Core Paper XI - Environmental and Industrial Biotechnology	5	4	25	75	100
	* Elective I - Nano Biotechnology / Enzymology /Bioethics and Biosafety / Cancer Biology	4	3	25	75	100
	Core Practical XII – Plant Biotechnology and Animal Biotechnology	5	4	25	75	100
	Elective Generic/Discipline Specific	4	3	25	75	100
Part- V	Value Education	2	2	25	75	100

Part VI	Summer Internship /Industrial Training	--	2	25	75	100
		30	26			

### SIXTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-III	Core Paper XIII – Bioentrepreneurship	6	5	25	75	100
	Core Paper XIV– Pharmaceutical Biotechnology	6	5	25	75	100
	* Elective II - Marine Biotechnology / Food Technology	4	4	25	75	100
	* Elective III - Medical Biotechnology / Forensic science / Good Laboratory Practices	4	4	25	75	100
Part IV	Core Paper = XV Project	10	5	25	75	100
Part V	Skill based Activities - Online Course-NPTEL/MOOC	-	1			
Part VI	Extension Activities	2	1			
			25			

### 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
<b>Learning Objective: On successful completion of the course, students will be able to</b>									
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.	
<b>UNIT</b>	<b>Contents</b>	<b>No.of Hours</b>
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 - Protein Sorting - Protein degradation.	15
IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.	15
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
<b>Total</b>		<b>75</b>
<b>Text Books</b>		
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, 11 <sup>th</sup> edition. Sinauer Associates Inc. Publishers, MA. USA.	
4	Bruce Alberts, 6 <sup>th</sup> 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.	
<b>Reference Books</b>		



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

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

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

### Allied Paper I- BIOLOGICAL CHEMISTRY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	3	1			3	4	25	75	100
<b>Learning Objective</b>									
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 and 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.								
<b>UNIT</b>	<b>Contents</b>								<b>No.of Hours</b>
I	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. Electrophilic substitution reaction in benzene, nitration and sulphonation.								15
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,								15

	mechanism of buffer action of acidic buffer and basic buffer.	
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 carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.	15
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.	15
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. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.	15
<b>Total</b>		<b>75</b>
<b>Text Books</b>		
1	P.L. Soni , A Text-book of Inorganic Chemistry, 11 <sup>th</sup> Edition, S. Chand & Sons publications	
2	Abhilasha Shourie, Shilpa S, Chapadgoankar& Anamika Singh (2020) Textbook of Biochemistry 1 <sup>st</sup> 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 3 <sup>rd</sup> edition (2006).	
<b>Reference Books</b>		
1	Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY	
2	Murray <i>et al.</i> , (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 Freeman and company San Francisco
5	Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22 <sup>nd</sup> Edition, S. Chand & Sons publications
<b>Web Resources</b>	
1	<a href="http://dwb4.unl.edu/chem869p/chem869plinks/s">http://dwb4.unl.edu/chem869p/chem869plinks/s</a>
2	<a href="http://www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp">www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp</a>
3	<a href="https://www.britannica.com/science/biochemistry">https://www.britannica.com/science/biochemistry</a>
4	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences</a>
5	<a href="https://biochemistry.org/education/careers/becoming-a-bioscientist">https://biochemistry.org/education/careers/becoming-a-bioscientist</a>

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	3	1	3	2	2	3	3	3
<b>CLO2</b>	3	2	1	3	2	2	3	3	3
<b>CLO3</b>	3	1	2	3	2	2	3	3	3
<b>CLO4</b>	3	2	3	3	2	1	3	3	3
<b>CLO5</b>	3	2	3	2	2	2	3	2	3
<b>TOTAL</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>14</b>	<b>10</b>	<b>9</b>	<b>15</b>	<b>14</b>	<b>15</b>
<b>AVERAG</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2.8</b>	<b>2</b>	<b>1.8</b>	<b>3</b>	<b>2.8</b>	<b>3</b>

<b>E</b>									
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### Practical - I CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
			4		2	4	25	75	100
<b>Learning Objective</b>									
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.								
<b>UNIT</b>	<b>Contents</b>								<b>No.of Hours</b>
I	Components of a Compound / Light Microscope.								4
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,								4
IV	Observation of sperm & Egg Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.								5
V	Cell fractionation and Identification of cell organelles (Demo)								3
VI	<b>Qualitative Analysis</b> Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.								7

VII	<b>Volumetric Analysis:</b> 1. Estimation of Glycine- Formal Titration. 2. Determination of Ascorbic acid – DCPIP method. 3. Estimation of Ferrous sulphate using standard Mohr's salt	7
VIII	<b>Colorimetric Analysis</b> 1. Estimation of glucose 2. Estimation of Cholesterol- Zak's method 3. Estimation of proteins – Bradford's method	7
<b>Total</b>		<b>45</b>
<b>Text Books</b>		
1	K.V. Chaitanya, (2013), <i>Cell and molecular biology: Lab manual</i> , PHI publishers,. ISBN 978-81-203-800-4	
2.	J. Jayaraman, <i>Laboratory Manual in Biochemistry</i> , New Age International Pvt Ltd Publishers, 2011.	

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

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



## Skill Enhancement (SEC-1)

### MUSHROOM CULTIVATION

L T P C

2 0 0 2

#### Course outcome:

On completion of this course, the students will be able to demonstrate the various types of mushroom cultivating methods and Value the economic factors associated with mushroom cultivation.

#### Unit – I:

Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms. (6)

#### Unit – II:

Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry. (5)

#### Unit – III:

Life cycle of Pleurotus spp and Agaricus spp. (4)

#### Unit – IV:

Spawn production, growth media, spawn running and harvesting of mushrooms and marketing. (6)

#### Unit – V:

Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.(8)

#### References:

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. 5. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.

5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
6. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
7. Handbook of Edible Mushroom Today and Tomorrows printers and publishers.
8. Sharma V.P. 2006. Diseases and Pests of Mushrooms, M/s. IBD Publishers and Distributors, New Delhi.
9. Tewari, P and Kapoor, S.C.1988. Mushroom cultivation, Mittal Publications New Delhi.
10. Bahl, N. (1984-1988). Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

## Foundation Course

### Basics of Biotechnology

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	2				2	2	25	75	100
<b>Learning Objective</b>									
LO1	To ease the transition of learning from higher secondary to higher education. 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	Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication, Transcription and Translation and post translational modifications of proteins.								
LO3	Understand the classification of Microorganisms and structure of bacteria.								
LO4	Explain the role of immune cells and their mechanism in body defense mechanism & demonstrate the antigen –antibody reactions in various immune techniques.								
LO5	Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.								
<b>UNIT</b>	<b>Contents</b>								<b>No. of</b>

		<b>Hours</b>
I	Introduction to Biotechnology and Cell Biology: Diversity of cell size and shape. Cell theory, Protoplasm theory, Isolation and growth of cells; Basic properties of cells; Different classes of cells – Prokaryotic and eukaryotic cells.	6
II	Molecular biology: Prokaryotic and Eukaryotic DNA replication, Prokaryotic & Eukaryotic Transcription & Translation, lac operon	5
III	Fundamentals of Microbiology: Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.	6
IV	Immunology: Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T lymphocytes & B lymphocytes	6
V	Recombinant DNA Technology: Molecular tools and applications- restriction enzymes, ligases, Cloning vectors (Natural Plasmid-F, R, Col, Degradative & Virulence. Artificial Plasmid-P <sup>BR322</sup> ), Microinjection, Electroporation, Use of Agrobacterium tumefaciens in transgenic plants.	7
<b>Total</b>		<b>30</b>
<b>Text Books</b>		
1	T. Devasena (2012), Cell Biology, Oxford University Press.	
2	Bruce Alberts, 6 <sup>th</sup> Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.	
3	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.  Prescott, Harley, Klein, Microbiology, 10 <sup>th</sup> Edition, McGraw – Hill, 2016.	
4	Nandini Shetty, 1996, Immunology : introductory textbook – I. New Age International, New Delhi.	

5	Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.
<b>Reference Books</b>	
1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8 <sup>th</sup> Edition (2015). Wiley Publications.
2	LodishHarvey, 6 <sup>th</sup> Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
3	Boyd, R.F. (1998). General Microbiology, 2 <sup>nd</sup> Edition., Times Mirror, Mosby College Publishing, St Louis.
4	Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 12th edition, Wiley- Blackwell. USA.
5	Primrose.S.B (2014), <i>Principles of gene manipulation</i> , (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3
<b>Web Resources</b>	
1	<a href="http://www.cellbiol.com/education.php">http://www.cellbiol.com/education.php</a>
2	<a href="https://dnalc.cshl.edu/websites/">https://dnalc.cshl.edu/websites/</a>
3	<a href="https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology">https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology</a>
4	<a href="https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/">https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/</a>
5	<a href="https://www.britannica.com/recombinant-DNA-technology">https://www.britannica.com/recombinant-DNA-technology</a>

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

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CLO1</b>	3	3	1	3	2	2	3	3	3
<b>CLO2</b>	3	2	1	3	2	2	3	3	3

<b>CLO3</b>	3	1	2	3	2	2	3	3	3
<b>CLO4</b>	3	2	3	3	2	1	3	3	3
<b>CLO5</b>	3	2	3	2	2	2	3	2	3
<b>TOTAL</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>14</b>	<b>10</b>	<b>9</b>	<b>15</b>	<b>14</b>	<b>15</b>
<b>AVERAG E</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2.8</b>	<b>2</b>	<b>1.8</b>	<b>3</b>	<b>2.8</b>	<b>3</b>

## SEMESTER – II

### CORE II GENETICS

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	4	1			5	5	25	75	100
Learning Objective									
LO1	Learn about the classical genetics and transmission of characters from one generation to the next.								
LO2	Obtain a strong foundation for the advanced genetics.								
LO3	Explain the properties of genetic materials and storage and processing of genetic information.								
LO4	Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.								
LO5	Categories Eugenics, Euphenics and Euthenics and indepth Knowledge on population Genetics.								

UNIT	Contents	No.of Hours
I	Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.	15
II	Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor inmice. Sex –Linked Inheritance and Sex- Determination in Man.	15
III	Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sexduction	15
IV	Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)	15
V	Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.	15
<b>Total</b>		75
<b>Text Books</b>		
1	Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram	
2	NathPublications,Meerut,250001.www.knrnpublications.com, ISBN-978-81-907011-2-9	
3	Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8 <sup>th</sup> edition, S.Chand& Co., New Delhi – 10055.	
4	Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8 <sup>th</sup> edition, S.Chand and Co., New Delhi, 110055.	

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

### **MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CLO1</b>	3	3	3	3	2	3	3	2	2
<b>CLO2</b>	3	3	3	3	3	3	3	2	2
<b>CLO3</b>	3	3	3	3	3	3	3	3	3
<b>CLO4</b>	3	2	3	3	3	3	3	3	3
<b>CLO5</b>	3	3	2	3	2	2	2	3	3

<b>TOTAL</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>13</b>	<b>14</b>	<b>14</b>	<b>13</b>	<b>13</b>
<b>AVERAGE</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>	<b>2.6</b>	<b>2.6</b>

### Allied Paper II FUNDAMENTALS OF MICROBIOLOGY

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	3	1			3	4	25	75	100
<b>Learning Objective</b>									
LO1	Understand the classification of Microorganisms and structure of bacteria								
LO2	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.								
LO3	Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes.								
LO4	Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizers, prebiotics and probiotics.								
LO5	Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications.								
UNIT	Contents								No. of Hours
I	History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology.								15
II	Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram's, capsule,								15



	spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae.	
III	Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL.	15
IV	Bioinsecticides - <i>Bacillus thuringiensis</i> , Baculoviruses- Biofertilizers - <i>Azospirillum</i> and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).	15
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).	15
<b>Total</b>		<b>75</b>
<b>Text Books</b>		
1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.	
2	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.	
3	Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013.	
4	Prescott, Harley, Klein, Microbiology, 10 <sup>th</sup> Edition, McGraw – Hill, 2016.	
5	Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC	
<b>Reference Books</b>		
1	Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14 <sup>th</sup> edition, 2017.	
2	Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4 <sup>th</sup> edition, 2012.	
3	Boyd, R.F. (1998). General Microbiology,2 <sup>nd</sup> Edition., Times Mirror, Mosby CollegePublishing, St Louis.	

4	Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11 <sup>th</sup> Edition., A La Carte Pearson.
5	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7 <sup>th</sup> Edition., McGraw Hill Inc.New York.

<b>Web Resources</b>	
1	<u>Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB)</u>
2	<u>http://www.ejb.org/content.</u>
3	<u>www. Biotech.kth.se Electronic Journal of biotechnology</u>
4	<u>https://www.cliffsnotes.com/study_guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology</u>
5	<u>https://bio.libretexts.org/@go/page/9188</u>

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

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

**Core Practical II - Genetics**

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CI A	External	Total
			4		2	4	25	75	100
<b>Learning Objective</b>									
LO1	Demonstrate the basic principles of important techniques in Molecular biology and Genetics.								
LO2	Analyze the Polytene chromosome of the organisms								
LO3	Identify Barr bodies from Buccal smear								
LO4	Demonstrate the Preparations and maintenance of culture medium								
LO5	Demonstrate Human karyotyping								
UNIT	Contents								No. of Hours
I	Mitotic stages of onion ( <i>Allium cepa</i> ) root tip Meiotic stages of cockroach testes/ Flower bud								9
II	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands								9
III	Identification of Barr bodies from Buccal smear								9
IV	Preparations of culture medium and culture of Drosophila – methods of maintenance Identifications of mutants of Drosophila								9
V	Human karyotyping (Demo)								9



<b>CLO3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CLO5</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>TOTAL</b>	<b>15</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>14</b>	<b>14</b>
<b>AVERAGE</b>	<b>3</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>

**SKIL ENHANCEMENT COURSE**  
**SEC-2: VERMITECHNOLOGY**

**L T P C**

**2 0 0 2**

**Course outcome:**

Students will gain knowledge on types of the earthworm culture methods, vermicomposting and its economical benefits.

**Unit – I:**

Types, Collection and Preservation of earthworms - Types and basic characteristics of species suitable for vermicomposting; Role of earth worms in soil fertility, Biology of *Lampitomarutti*; Collection and Preservation of Earthworms; Flow sheet for vermi technology.

**Unit – 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.

**Unit – III:**

Small scale techniques of Vermicomposting - Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost.

**Unit – IV:**

Large scale techniques of Vermicomposting Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan.

**Unit – V:**

Vermiwash and Economics - Chemical composition of vermiwash; Techniques of vermiwash production: Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.

**References:**

1. The Earthworm book, Ismail, S.A., other India Press, Goa
2. Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
3. Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.
4. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.





**SKIL ENHANCEMENT COURSE**  
**SEC-3: ESSENTIAL OIL PREPARATIONS**

**L T P C**

**2 0 0 2**

**Objective:** This course will give an idea about the application of Essential oil preparation, particularly it produceself employment. This focuses on the Source of raw material, Extraction methods, Registration, packing and marketing.

**Course Outcomes**

On completion of the course, the students will be able to

CO. No.	ESSENTIAL OIL PREPARATIONS	Cognitive Level
CO1	Understand the Prepare essential oils - Source, distribution and applications. Factors affecting the yield and quality. Aromatherapy uses.	K1, K3,K3
CO2	Characterize- boiling point, volatility and solubility, physicochemical properties and Constituents of essential oils.	K2 ,K3
CO3	Extract the oils using methods –Distillation-Steam distillation, Hydrodistillation,Maceration, Solvent extraction, distillation apparatus, Advantages	K3, K4
CO4	Identify plants yielding essential oil - Morphology, Method of extraction, Useful part, Medicinal uses of Clove, Sandal, Lemongrass, Eucalyptus and Peppermint	K2,K3,K4
CO5	Develop the registration. Packing, Storage and utilisation of essential oils. Quality & purity, Grade, Pricing and marketing, Economic benefits.	K4, K5, K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

## ESSENTIAL OIL PREPARATIONS

### Unit I

Essential oils - Source, distribution and applications. Factors affecting the yield and quality.

Aromatherapy uses. **(5L)**

### Unit II

Characterization- boiling point, volatility and solubility, physicochemical properties and

Constituents of essential oils. **(5L)**

### Unit III

Extraction methods –Distillation-Steam distillation, Hydrodistillation, Maceration, Solvent extraction, distillation apparatus, Advantages, LC-MS. **(7L)**

### Unit IV

Plants yielding essential oil - Morphology, Method of extraction, Useful part, Medicinal uses of Clove, Sandal, Lemongrass, Eucalyptus and Peppermint. **(7L)**

### Unit V

Registration. Packing, Storage and utilisation of essential oils. Quality & purity, Grade, Pricing and marketing, Economic benefits. **(6L)**

**Total (30L)**

### References

- Aromatic and Medicinal plants, yielding essential oil for pharmaceutical perfumery and cosmetic industry and Trade by Shiva M.P (2002).
- Aromatic and vital oil plants by Rajkumar Joshi. Agrotech press New Delhi.(2013).

**Mapping**

<b>ESSENTIAL OIL PREPARATIONS</b>												
<b>CO/PO/PSO</b>	<b>PO</b>							<b>PSO</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>1</b>	2	3	3	3	3	3	3	3	3	3	2	3
<b>2</b>	2	3	3	3	3	3	3	3	3	3	2	3
<b>3</b>	3	3	3	3	3	3	2	3	3	3	2	3
<b>4</b>	3	3	3	3	3	3	2	3	3	2	3	3
<b>5</b>	3	3	3	2	3	3	2	3	3	2	3	3
<b>6</b>	3	3	3	2	3	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)