

**D.K.M COLLEGE FOR WOMEN  
(AUTONOMOUS) VELLORE**



**DEPARTMENT OF BIOTECHNOLOGY**

**SYLLABUS FOR BACHELOR DEGREE COURSE  
IN BIOTECHNOLOGY**

**WITH EFFECT FROM 2024-2025**

**UG Department of Biotechnology with effect from 2024-2025**  
**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum**  
**Framework (LOCF) PATTERN**  
**The course of study and Scheme of Examination**

| S. No             | Part      | Category                   | Ins. Hrs/Week | Credit | Title of the paper                       | Maximum marks |           |       |
|-------------------|-----------|----------------------------|---------------|--------|--|---------------|-----------|-------|
|                   |           |                            |               |        |  | CIA           | Sem. Exam | Total |
| <b>SEMESTER I</b> |           |                            |               |        |  |               |           |       |
| 1                 | Part I    | Language                   | 6             | 3      | Tamil Paper – I                          | 25            | 75        | 100   |
| 2                 | Part - II | English Paper – I          | 6             | 3      | English Paper – I                        | 25            | 75        | 100   |
| 3                 | Part III  | Core Paper I -             | 5             | 5      | Cell and Molecular Developmental Biology | 25            | 75        | 100   |
| 4                 | Part III  | Core Practical I -         | 3             | 3      | Cell and Molecular Developmental Biology | 25            | 75        | 100   |
| 5                 | Part III  | Allied Paper I             | 4             | 3      | - Biological Chemistry                   | 25            | 75        | 100   |
| 6                 | Part III  | Allied Practical I -       | 2             | 2      | Biological Chemistry                     | 25            | 75        | 100   |
| 7                 | Part IV   | Skill Enhancement Course-1 | 2             | 2      | Public Health & Hygiene                  | 25            | 75        | 100   |
| 8                 | Part IV   | Foundation Course          | 2             | 2      | Foundation Course                        | 25            | 75        | 100   |
|                   |           |                            | 30            | 23     |  |               |           | 800   |

| S. No              | Part      | Category            | Ins. Hrs/Week | Credit    | Title of the paper                    | Maximum marks |           |       |
|--------------------|-----------|---------------------|---------------|-----------|---------------------------------------|---------------|-----------|-------|
|                    |           |                     |               |           |                                       | CIA           | Sem. Exam | Total |
| <b>SEMESTER II</b> |           |                     |               |           |                                       |               |           |       |
| 1                  | Part I    | Language-II         | 6             | 3         | Tamil Paper – II                      | 25            | 75        | 100   |
| 2                  | Part - II | English Paper – II  | 6             | 3         | English Paper – II                    | 25            | 75        | 100   |
| 3                  | Part III  | Core Paper II -     | 5             | 5         | Genetics                              | 25            | 75        | 100   |
| 4                  | Part III  | Core Practical II - | 3             | 3         | Genetics                              | 25            | 75        | 100   |
| 5                  | Part III  | Allied Paper II     | 4             | 3         | Fundamentals of Microbiology          | 25            | 75        | 100   |
| 6                  | Part III  | Allied Practical II | 2             | 2         | Fundamentals of Microbiology          | 25            | 75        | 100   |
| 7                  | Part IV   | Skill Enhancement-2 | 2             | 2         | Organic Farming and Health Management | 25            | 75        | 100   |
| 8                  | Part IV   | Skill Enhancement-3 | 2             | 2         | Vermitechnology                       | 25            | 75        | 100   |
|                    |           |                     | <b>30</b>     | <b>23</b> |                                       |               |           | 800   |

| S. No               | Part      | Category               | Ins. Hrs/Week | Credit | Title of the paper              | Maximum marks |           |       |
|---------------------|-----------|------------------------|---------------|--------|---------------------------------|---------------|-----------|-------|
|                     |           |                        |               |        |                                 | CIA           | Sem. Exam | Total |
| <b>SEMESTER III</b> |           |                        |               |        |                                 |               |           |       |
| 1                   | Part I    | Language-III           | 6             | 3      | Tamil Paper – III               | 25            | 75        | 100   |
| 2                   | Part - II | English Paper – III    | 6             | 3      | English Paper – III             | 25            | 75        | 100   |
| 3                   | Part III  | Core Paper III -       | 5             | 5      | Immunology and Immunotechnology | 25            | 75        | 100   |
| 4                   | Part III  | Core Practical III     | 3             | 3      | Immunology and Immunotechnology | 25            | 75        | 100   |
| 5                   | Part III  | Allied Paper III       | 4             | 3      | Bioinstrumentation              | 25            | 75        | 100   |
| 6                   | Part III  | Allied Practical III - | 2             | 2      | Bioinstrumentation              | 25            | 75        | 100   |
| 7                   | Part IV   | Skill Enhancement-4    | 2             | 2      | Herbal Medicine                 | 25            | 75        | 100   |
| 8                   | Part IV   | Skill Enhancement-5    | 1             | 1      | Mushroom Cultivation            | 25            | 75        | 100   |
| 9                   | Part IV   | Environmental Studies* | 1             | 2      | Environmental Studies           | -             | -         | -     |
|                     |           |                        | 30            | 24     |                                 |               |           | 800   |

- Examination will be held in IV Semester

| S. No              | Part      | Category              | Ins. Hrs/Week | Credit | Title of the paper                      | Maximum marks |           |       |
|--------------------|-----------|-----------------------|---------------|--------|---|---------------|-----------|-------|
|                    |           |                       |               |        |   | CIA           | Sem. Exam | Total |
| <b>SEMESTER IV</b> |           |                       |               |        |   |               |           |       |
| 1                  | Part I    | Language-IV           | 6             | 3      | Tamil Paper – IV                        | 25            | 75        | 100   |
| 2                  | Part - II | English Paper - IV    | 6             | 3      | English Paper – IV                      | 25            | 75        | 100   |
| 3                  | Part III  | Core Paper IV         | 5             | 5      | Genetic Engineering and rDNA Technology | 25            | 75        | 100   |
| 4                  | Part III  | Core Practical IV     | 3             | 3      | Genetic Engineering and rDNA Technology | 25            | 75        | 100   |
| 5                  | Part III  | Allied Paper IV       | 4             | 3      | Bioinformatics and Biostatistics        | 25            | 75        | 100   |
| 6                  | Part III  | Allied Practical IV   | 2             | 2      | Bioinformatics and Biostatistics        | 25            | 75        | 100   |
| 7                  | Part IV   | Skill Enhancement-6   | 2             | 2      | Food and Nutrition                      | 25            | 75        | 100   |
| 8                  | Part IV   | Skill Enhancement-7   | 2             | 2      | Aquaculture                             | 25            | 75        | 100   |
| 9                  | Part IV   | Environmental Studies | -             | 2      | Environmental Studies                   | 25            | 75        | 100   |
|                    |           |                       | 30            | 25     |   |               |           | 900   |

| S. No             | Part     | Category          | Ins. Hrs/Week | Credit | Title of the paper   | Maximum marks |           |       |
|-------------------|----------|-------------------|---------------|--------|--|---------------|-----------|-------|
|                   |          |                   |               |        |  | CIA           | Sem. Exam | Total |
| <b>SEMESTER V</b> |          |                   |               |        |  |               |           |       |
| 1                 | Part III | Core Paper V      | 5             | 4      | Plant Biotechnology  | 25            | 75        | 100   |
| 2                 | Part III | Core Paper VI     | 5             | 4      | Animal Biotechnology   | 25            | 75        | 100   |
| 3                 | Part III | Core Paper VII    | 5             | 4      | Environmental and Industrial Biotechnology                                 | 25            | 75        | 100   |
| 4                 | Part III | Elective I        | 4             | 3      | Nano Biotechnology / Enzymology / Bioethics and Biosafety / Cancer Biology | 25            | 75        | 100   |
| 5                 | Part III | Core Practical V  | 5             | 4      | Plant Biotechnology and Animal Biotechnology                               | 25            | 75        | 100   |
| 6                 |          | Core Practical VI | 4             | 3      | Environmental and Industrial Biotechnology                                 | 25            | 75        | 100   |
| 7                 | Part IV  | Internship        | -             | 2      |  | -             | -         | -     |
| 8                 |          | Value Education   | 2             | 2      | Foundation Course  | 25            | 75        | 100   |
|                   |          |                   | 30            | 26     |  |               |           | 700   |

| S. No              | Part     | Category                         | Ins. Hrs/Week | Credit | Title of the paper   | Maximum marks |           |       |
|--------------------|----------|----------------------------------|---------------|--------|--|---------------|-----------|-------|
|                    |          |                                  |               |        |  | CIA           | Sem. Exam | Total |
| <b>SEMESTER VI</b> |          |                                  |               |        |  |               |           |       |
| 1                  | Part III | Core Paper VIII                  | 6             | 4      | Bioentrepreneurship  | 25            | 75        | 100   |
| 2                  | Part III | Core Paper IX                    | 6             | 4      | Pharmaceutical Biotechnology   | 25            | 75        | 100   |
| 3                  | Part III | Elective VI                      | 5             | 3      | Marine Biotechnology / Food Technology                               | 25            | 75        | 100   |
| 4                  | Part III | Elective III                     | 5             | 3      | Medical Biotechnology / Forensic science / Good Laboratory Practices | 25            | 75        | 100   |
| 5                  | Part III | Project                          | 6             | 4      | Project  | 25            | 75        | 100   |
| 6                  | Part IV  | Preparation for Competitive Exam | 2             | 2      | Preparation for Competitive Exam                                     | 25            | 75        | 100   |
| 7                  | Part V   | Extension Activities             | 0             | 1      | -  | -             | -         | -     |
|                    |          |                                  | 30            | 21     |  |               |           | 600   |

## Consolidated Table for Credit Distribution

| Part         | Subject | Papers | Credit | Total credits | Marks | Total Marks |
|--------------|---------|--------|--------|---------------|-------|-------------|
| Part-1       | Tamil   | 4      | 3      | 12            | 100   | 400         |
| Part-2       | English | 4      | 3      | 12            | 100   | 400         |
| <b>Total</b> |         |        |        | <b>24</b>     |       | 800         |

| Part         | Subject              | Papers | Credit | Total credits | Marks | Total Marks |
|--------------|----------------------|--------|--------|---------------|-------|-------------|
| III          | Core course (Theory) | 4      | 5      | 20            | 100   | 400         |
|              |                      | 5      | 4      | 20            | 100   | 500         |
|              | Allied (Theory)      | 4      | 3      | 12            | 100   | 800         |
| III          | Core practical       | 5      | 3      | 15            | 100   | 500         |
|              | Core practical       | 1      | 4      | 4             | 100   | 100         |
|              | Allied practical     | 4      | 2      | 8             | 100   | 400         |
|              | Elective( Theory)    | 3      | 3      | 9             | 100   | 300         |
| III          | Project              | 1      | 4      | 4             | 100   | 100         |
| <b>Total</b> |                      |        |        | <b>92</b>     |       | 3.100       |

| Part    | Subject                          | Papers | Credit  | Total credits | Marks | Total Marks |
|---------|----------------------------------|--------|---------|---------------|-------|-------------|
| Part IV | Foundation Course                | 1      | 2       | 2             | 100   | 100         |
| Part IV | Skill Enhancement                | 6      | 2       | 12            | 100   | 600         |
| Part IV | Skill Enhancement                | 1      | 1       | 1             | 100   | 100         |
|         | Environmental Studies            | 1      | 2       | 2             | 100   | 100         |
| Part IV | Internship                       | 1      | 2       | 2             | -     | -           |
|         | Value Education                  | 1      | 2       | 2             | 100   | 100         |
| Part IV | Preparation for Competitive Exam | 1      | 2       | 2             | 100   | 100         |
|         |                                  | Total  |         | 23            |       | 1100        |
| Part V  | Extension Activities             | 0      | 1       | -             | -     | -           |
|         |                                  |        | 1       |               |       |             |
|         |                                  |        | 23+1=24 |               |       |             |

**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            | 2             | 23                   |
| <b>Part V</b>   | -            | -             | -              | -             | -            | 1             | 1                    |
| <b>Total</b>    | 23           | 23            | 22             | 25            | 26           | 21            | <b>140</b>           |

| <b>CHOICE BASED CREDIT SYSTEM AND LEARNING OUTCOMES BASED CURRICULUM, LEARNING OUTCOMES BASED CURRICULUM - FRAMEWORK - B.Sc. Biotechnology</b> |  |
|--|--|
| <b>Programme:</b>  | <b>B.Sc. Biotechnology</b>   |
| <b>Programme Code:</b>   |  |
| <b>Duration:</b>   | <b>3 Years (UG)</b>  |
| <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 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</p> |

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|  | <p>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 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</p>   |

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|  | development, and contribute to the growth and development of their field. |
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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:**

| Semester         | Newly introduced Components   | Outcome / Benefits  |
|------------------|---|---|
| I                | <b>Foundation Course</b><br>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. | <ul style="list-style-type: none"> <li>● Instil confidence among students</li> <li>● Create interest for the subject</li> </ul>   |
| I, II, III, IV   | <b>Skill Enhancement papers</b> (Discipline centric / Generic / Entrepreneurial)  | <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> |
| III, IV, V & VI  | Elective papers-<br>An open choice of topics categorized under Generic and Discipline Centric   | <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> <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>  |
| IV               | 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>   |
| II year Vacation | Internship / Industrial Training  | <ul style="list-style-type: none"> <li>● Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational</li> </ul>   |

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| activity  |   | institutions, enable the students gain professional experience and also become responsible citizens.   |
| V Semester  | 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>   |
| VI Semester   | 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> |
| Extra Credits:<br>For Advanced Learners / Honors degree |   | <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 |  |

**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.  |   |   |   |         |                     |       |           |              |
| 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 - Cell to cell communications.   |   |   |   |         |                     |       |           | 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, Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization.                                 |   |   |   |         |                     |       |          | 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, 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 carbohydrates. 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. Beta 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. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.   |   |   |   |         |                     |       |          | 10                  |
| <b>Total</b>              |   |   |   |   |         |                     |       | 60       |                     |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |          |                     |

|                        |   |
|------------------------|---|
| 1                      | P.L. Soni , A Text-book of Inorganic Chemistry, 11 <sup>th</sup> Edition, S. Chand & Sons publications  |
| 2                      | AbhilashaShourie, 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 Biochemistry 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                      | LubertStryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco   |
| 5                      | BahlArun, 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/w">https://biochemistry.org/education/careers/becoming-a-bioscientist/w</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>AVERAGE</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>  |

**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                 |
| <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.   |   |   |   |         |                     |       |           | 9                   |
| II                        | Blood smear preparation and Identification of Blood cells<br>Buccal smear preparation and Identification of squamous epithelial cells.         |   |   |   |         |                     |       |           | 9                   |
| III                       | Isolation and Identification of plant cells.   |   |   |   |         |                     |       |           | 9                   |
| IV                        | Observation of sperm & Egg (Demo)<br>Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. (Demo)<br>Types of placenta in mammals. (Demo) |   |   |   |         |                     |       |           | 9                   |
| V                         | Cell fractionation and Identification of cell organelles (Demo)  |   |   |   |         |                     |       |           | 9                   |
| <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                                 |   |   |   |         |                     |       |           |                     |

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

|                | PO1       | PO2        | PO3        | PO4       | PO5        | PO6        | PSO1       | PSO2       | PSO3       |
|----------------|-----------|------------|------------|-----------|------------|------------|------------|------------|------------|
| <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 Practical I-BIOLOGICAL CHEMISTRY

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |                     |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|---------------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total               |
|                           |   |   | 2 |   | 2       | 2                   | 25    | 75        | 100                 |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |           |                     |
| 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 Sorenson's formal titration method.  |   |   |   |         |                     |       |           |                     |
| LO5                       | Estimate Glucose, Cholesterol and Proteins.   |   |   |   |         |                     |       |           |                     |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |           | <b>No. of Hours</b> |
| 1                         | <b>Systematic analysis of Organic compounds</b><br>Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam))                           |   |   |   |         |                     |       |           | 5                   |
| II                        | <b>Qualitative Analysis</b><br>Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch.<br>Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine. |   |   |   |         |                     |       |           | 10                  |
| III                       | <b>Volumetric Analysis:</b><br>1. Estimation of Glycine- Formal Titration.<br>2. Determination of Ascorbic acid – DCPIP method.<br>3. Estimation of Ferrous sulphate using standard Mohr's salt                             |   |   |   |         |                     |       |           | 5                   |
| IV                        | Colorimetric Analysis<br>1. Estimation of glucose<br>2. Estimation of Cholesterol- Zak's method<br>3. Estimation of proteins – Lowry's method   |   |   |   |         |                     |       |           | 10                  |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>30</b> |                     |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |           |                     |
| 1                         | J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.  |   |   |   |         |                     |       |           |                     |
| 2                         | S. K. SawhneyRandhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2 <sup>nd</sup> edition, 2005.   |   |   |   |         |                     |       |           |                     |
| 3                         | Irwin H.Segel, Biochemical calculations,Liss, Newyork,1991.   |   |   |   |         |                     |       |           |                     |
| <b>Reference Books</b>    |   |   |   |   |         |                     |       |           |                     |
| 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 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>  |

**SKILL ENHANCEMENT COURSE –1**  
**PUBLIC HEALTH AND HYGIENE**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External | Total        |
|                           | 2  |   |   |   | 2       | 2                   | 25    | 75       | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |              |
| 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 |
| I                         | Scope health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.   |   |   |   |         |                     |       |          | 5            |
| II                        | Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).   |   |   |   |         |                     |       |          | 5            |
| III                       | Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. Sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.  |   |   |   |         |                     |       |          | 5            |
| IV                        | Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy) Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral and lung cancer and their preventive measures. |   |   |   |         |                     |       |          | 10           |
| V                         | Health Services Organizations: World Health Organization (WHO), United Nations International Children’s Emergency Fund (UNICEF) and Indian Red Cross (IRC).  |   |   |   |         |                     |       |          | 5            |

|                        |  |           |
|------------------------|--|-----------|
| <b>Total</b>           |  | <b>30</b> |
| <b>Text Books</b>      |  |           |
| 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.   |           |
| <b>Reference Books</b> |  |           |
| 1                      | S. Lal, (2018), Vikas. <i>Public Health Management Principles And Practice</i> , 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.                |           |
| 2                      | Mary-Jane Schneider (2016), <i>Introduction to Public Health</i> , ( 5th Edition), Jones & Bartlett Learning,. ISBN-13: 978-1284197594   |           |
| 3                      | Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), <i>Handbook of Nutrition and Food</i> , (3rd Edition), CRC Press,. ISBN 9781466505711                              |           |
| 4                      | Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), <i>Principles of Occupational Health and Hygiene: An Introduction</i> , ( 2nd Revised ed. Edition), Allen &Unwin, |           |
| 5                      | V. Kumaresan, R. Sorna Raj, (2012) <i>Public Health and Hygiene</i> ,( 1st Edition), Saras Publication.  |           |

**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>    | <b>3</b>   | <b>3</b>   | <b>-</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>    | <b>3</b>   | <b>3</b>   | <b>-</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>    | <b>3</b>   | <b>3</b>   | <b>1</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO4</b>    | <b>3</b>   | <b>3</b>   | <b>1</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO5</b>    | <b>2</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>    | <b>2</b>    | <b>3</b>    |
| <b>TOTAL</b>   | <b>14</b>  | <b>15</b>  | <b>4</b>   | <b>11</b>  | <b>15</b>  | <b>15</b>  | <b>14</b>   | <b>14</b>   | <b>15</b>   |
| <b>Average</b> | <b>2.8</b> | <b>3</b>   | <b>0.8</b> | <b>2.2</b> | <b>3</b>   | <b>3</b>   | <b>2.8</b>  | <b>2.8</b>  | <b>3</b>    |

**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 Objectives:</b> |  |   |   |   |         |                     |       |          |       |
| LO1                         | <b>The student can understand the basics of biotechnology.</b>             |   |   |   |         |                     |       |          |       |
| LO2                         | <b>Able to explain the basic concept of biotechnology.</b>                 |   |   |   |         |                     |       |          |       |
| LO3                         | <b>Can differentiate various types of biotechnology.</b>                   |   |   |   |         |                     |       |          |       |
| LO4                         | <b>Can outline various biotech based products used in day to day life.</b> |   |   |   |         |                     |       |          |       |
| LO5                         | <b>Apply the concepts of biotechnology in various fields.</b>              |   |   |   |         |                     |       |          |       |

**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.

**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                 |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                     |
| <b>LO1</b>                | Learn about the classical genetics and transmission of characters from one generation to the next.  |   |   |   |         |                     |       |          |                     |
| <b>LO2</b>                | Obtain a strong foundation for the advanced genetics.   |   |   |   |         |                     |       |          |                     |
| <b>LO3</b>                | Explain the properties of genetic materials and storage and processing of genetic information.  |   |   |   |         |                     |       |          |                     |
| <b>LO4</b>                | Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.  |   |   |   |         |                     |       |          |                     |
| <b>LO5</b>                | Categories Eugenics, Euphenics and Euthenics and indepth Knowledge on population Genetics.  |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| 1                         | Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance, Codominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles. 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. Sex –Linked Inheritance and Sex- Determination in Man.                    |   |   |   |         |                     |       |          | 15                  |
| III                       | Fine structure of the gene and gene concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction |   |   |   |         |                     |       |          | 15                  |
| 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), Karyotyping.   |   |   |   |         |                     |       |          | 15                  |
| V                         | Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics. Penetrance and Expressivity.   |   |   |   |         |                     |       |          | 15                  |

|                        |  |    |
|------------------------|--|----|
| <b>Total</b>           |  | 75 |
| <b>Text Books</b>      |  |    |
| 1                      | Dr. Veer BalaRastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, KedarNath Ram                              |    |
| 2                      | Nath Publications, Meerut, 250001. www.knrnpublications.com, ISBN-978-81-907011-2-9  |    |
| 3                      | Verma, P.S. and Agarwal, V.K., 1995. Genetics, 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.  |   |   |   |         |                     |       |           | 10           |
| II                        | Structure of bacteria - Bacterial growth and measurement of growth, Factors affecting growth. Media – types and preparation- plating methods - staining methods (Gram's, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae.  |   |   |   |         |                     |       |           | 15           |
| III                       | Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL.   |   |   |   |         |                     |       |           | 10           |
| 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).   |   |   |   |         |                     |       |           | 10           |
| V                         | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Influenza), food borne disease (Shigellosis, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (HPV, Trichomoniasis), Vector borne disease (Dengue, Malaria). |   |   |   |         |                     |       |           | 15           |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>60</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 |

### Reference Books

|   |  |
|---|--|
| 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.             |

### Web Resources

|   |  |
|---|--|
| 1 | <u><a href="#">Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB)</a></u>   |
| 2 | <u><a href="http://www.ejb.org/content">http://www.ejb.org/content</a></u> .   |
| 3 | <u><a href="http://www.Biotech.kth.se">www. Biotech.kth.se</a> Electronic Journal of biotechnology</u>   |
| 4 | <u><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></u> |
| 5 | <u><a href="https://bio.libretexts.org/@go/page/9188">https://bio.libretexts.org/@go/page/9188</a></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>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <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>  |

**Core Practical II - Genetics**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
|                           |   |   | 3 |   | 3       | 3                   | 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<br>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   |   |   |   |         |                     |       |           | 9            |
| V                         | Human karyotyping (Demo)  |   |   |   |         |                     |       |           | 9            |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>45</b> |              |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |           |              |
| 1                         | Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First<br>Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi |   |   |   |         |                     |       |           |              |

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

|                | <b>PO1</b> | <b>PO<br/>2</b> | <b>PO3</b> | <b>PO<br/>4</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>  |

**ALLIED PRACTICAL II -FUNDAMENTALS OF MICROBIOLOGY**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
|                           |   |   | 2 |   | 2       | 2                   | 25    | 75        | 100          |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |           |              |
| LO1                       | Describe the general Laboratory safety & Sterilization Techniques   |   |   |   |         |                     |       |           |              |
| LO2                       | Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques                       |   |   |   |         |                     |       |           |              |
| LO3                       | Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques.              |   |   |   |         |                     |       |           |              |
| LO4                       | Perform the Motility of organisms.  |   |   |   |         |                     |       |           |              |
| LO5                       | Able to characterize and identify bacteria using Biochemical tests.   |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents  |   |   |   |         |                     |       |           | No. of Hours |
| I                         | Sterilization techniques – Preparation of Media   |   |   |   |         |                     |       |           | 5            |
| II                        | Inoculation techniques- Pour plate, spread plate and streaking plate. Isolation of bacteria from water by dilution technique. |   |   |   |         |                     |       |           | 10           |
| III                       | Staining techniques: Simple positive, simple negative, Gram's staining. Lacto phenol cotton blue staining.                    |   |   |   |         |                     |       |           | 5            |
| IV                        | Motility tests: Hanging drop technique.   |   |   |   |         |                     |       |           | 5            |
| V                         | Biochemical characterization - IMVIC test and TSI. Antibiotic sensitivity test.   |   |   |   |         |                     |       |           | 5            |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>30</b> |              |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |           |              |
| 1                         | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.                                      |   |   |   |         |                     |       |           |              |
| 2                         | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.   |   |   |   |         |                     |       |           |              |
| 3                         | Sundararaj T (2005). Microbiology Lab Manual (1 <sup>st</sup> edition) publications.  |   |   |   |         |                     |       |           |              |
| 4                         | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.                  |   |   |   |         |                     |       |           |              |
| 5                         | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.  |   |   |   |         |                     |       |           |              |
| <b>Reference Books</b>    |   |   |   |   |         |                     |       |           |              |

|                      |   |
|----------------------|---|
| 1                    | Atlas.R (1997). Principles of Microbiology, 2 <sup>nd</sup> Edition, Wm.C.Brown publishers.   |
| 2                    | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1 <sup>st</sup> Edition). Elsevier India.   |
| 3                    | Talib VH (2019). Handbook Medical Laboratory Technology. (2 <sup>nd</sup> Edition). CBS.  |
| 4                    | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.  |
| 5                    | Lim D. (1998). Microbiology, 2 <sup>nd</sup> Edition, WCB McGraw Hill Publications.   |
| <b>Web Resources</b> |   |
| 1                    | <a href="http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403">http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403</a> .   |
| 2                    | <a href="https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635">https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635</a>   |
| 3                    | <a href="https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf">https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf</a>   |
| 4                    | <a href="https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology">https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology</a> |

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

|                     | <b>P<br/>O<br/>1</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>         | <b>3</b>             | <b>2</b>   | <b>2</b>   | <b>2</b>   | <b>1</b>   | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>         | <b>3</b>             | <b>2</b>   | <b>2</b>   | <b>2</b>   | <b>1</b>   | <b>1</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>         | <b>3</b>             | <b>2</b>   | <b>1</b>   | <b>1</b>   | <b>-</b>   | <b>1</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO4</b>         | <b>3</b>             | <b>2</b>   | <b>1</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>2</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    |
| <b>TOTAL</b>        | <b>15</b>            | <b>11</b>  | <b>8</b>   | <b>10</b>  | <b>8</b>   | <b>8</b>   | <b>15</b>   | <b>14</b>   | <b>14</b>   |
| <b>AVERAG<br/>E</b> | <b>3</b>             | <b>2.2</b> | <b>1.6</b> | <b>2</b>   | <b>1.6</b> | <b>1.6</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

**SKILL ENHANCEMENT COURSE-2**  
**ORGANIC FARMING AND HEALTH MANAGEMENT**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
|                           | 2   |   |   |   | 2       | 2                   | 25    | 75        | 100          |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |           |              |
| LO1                       | The student will value the concepts of ecology and environment  |   |   |   |         |                     |       |           |              |
| LO2                       | To know the techniques of Vermicomposting and enjoying the cultivation of common Medicinal Herbs  |   |   |   |         |                     |       |           |              |
| LO3                       | To gain the knowledge about Principles and Policies in Organic forming and Certification agencies   |   |   |   |         |                     |       |           |              |
| LO4                       | To realize the Concept of Health and importance of well being   |   |   |   |         |                     |       |           |              |
| LO5                       | To appreciate the Role of exercise and nutrition in Health related fitness  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents  |   |   |   |         |                     |       |           | No. of Hours |
| I                         | Ecology and Environment – Principles of ecology – Ecosystem - Biotic and abiotic components and interaction – Energy flow –Nutrient cycle – Biodiversity – Endemic – Exotic - Interrelationships.   |   |   |   |         |                     |       |           | 5            |
| II                        | Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.   |   |   |   |         |                     |       |           | 5            |
| III                       | Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability. |   |   |   |         |                     |       |           | 5            |
| IV                        | Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.                                 |   |   |   |         |                     |       |           | 10           |
| V                         | Exercise and Health related fitness: Health related fitness, health promotion, and physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.   |   |   |   |         |                     |       |           | 5            |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>30</b> |              |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |           |              |
| 1                         | G.K. Veeresh, 2006. Organic farming, First edition, New Delhi, India Foundation Books in association with Centre for Environment Education.   |   |   |   |         |                     |       |           |              |



**SKILL ENHANCEMENT COURSE-3****VERMITECHNOLOGY****Course outcome:**

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

| 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 know the techniques of Vermicomposting and role of earthworms in soil fertility.  |   |   |   |         |                     |       |           |              |
| LO2                       | To practice the culturing techniques of earthworms and composting materials  |   |   |   |         |                     |       |           |              |
| LO3                       | To gain the knowledge about Small scale techniques of Vermicomposting  |   |   |   |         |                     |       |           |              |
| LO4                       | To realize the Concept of Large scale techniques of Vermicomposting  |   |   |   |         |                     |       |           |              |
| LO5                       | To appreciate the impact of Vermiwash and Economics  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |           | No. of Hours |
| 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 <i>Lampitomarutti</i> ; Collection and Preservation of Earthworms; Flow sheet for vermi technology |   |   |   |         |                     |       |           | 5            |
| 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  |   |   |   |         |                     |       |           | 5            |
| 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  |   |   |   |         |                     |       |           | 5            |
| IV                        | Large scale techniques of Vermicomposting Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan  |   |   |   |         |                     |       |           | 10           |
| V                         | Vermiwash and Economics - Chemical composition of vermiwash; Techniques of vermiwash production: Advantages of Vermicomposting; Prospects of vermi-culture as self-employment venture  |   |   |   |         |                     |       |           | 5            |
| <b>Total</b>              |  |   |   |   |         |                     |       | <b>30</b> |              |
| <b>Reference Books</b>    |  |   |   |   |         |                     |       |           |              |

|   |   |
|---|---|
| 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             |
| 3 | Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India |

**SEMESTER – III****Core IMMUNOLOGY AND IMMUNOTECHNOLOGY**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |  |   |   |   |         |                     | CI A  | External | Total               |
|                           | 4  | 1 |   |   | 3       | 3                   | 25    | 75       | 100                 |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |                     |
| LO1                       | Explain the role of immune cells and their mechanism in body defense mechanism.  |   |   |   |         |                     |       |          |                     |
| LO2                       | Demonstrate the antigen –antibody reactions in various immune techniques.  |   |   |   |         |                     |       |          |                     |
| LO3                       | Gain new insights into Antigen -Antibody interactions and to demonstrate immunological techniques.   |   |   |   |         |                     |       |          |                     |
| LO4                       | Gain knowledge of production of vaccines.  |   |   |   |         |                     |       |          |                     |
| LO5                       | Apply the knowledge of immune associated disease, hypersensitivity reactions.  |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| I                         | Introduction to Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired. |   |   |   |         |                     |       |          | 15                  |
| II                        | Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.                         |   |   |   |         |                     |       |          | 15                  |
| III                       | Antigen – Antibody interactions, Immunodiffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Flourescent antibody technique and Western Blotting.   |   |   |   |         |                     |       |          | 15                  |
| IV                        | The complement system and activation and regulation. Biological function of C' proteins. Cytokines- Structure and Function.  |   |   |   |         |                     |       |          | 15                  |
| V                         | Hypersensitivity Reactions and Types. Major Histocompatibility Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. Graft rejection,allograft  |   |   |   |         |                     |       |          | 15                  |

|                        |   |           |
|------------------------|---|-----------|
|                        | rejection.  |           |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Thomas J. Kindt, Barbara A. Osborne and Richard A Goldsby, 2006. Kuby Immunology. 6th edition, W. H . Freeman and Company.  |           |
| 2                      | Kannan, I., 2010. Immunology. MJP Publishers, Chennai   |           |
| 3                      | Abbas, A.K., A.H.L., Lihtman and S. Pillai, 2010. Cellular and Molecular Immunology, 6th Edition. Saunders Elsevier Publications, Philadelphia  |           |
| 4                      | NandiniShetty, 1996, Immunology : introductory textbook – I. New Age International, New Delhi.  |           |
| 5                      | Fahim Halim K.,2009. The Elements of Immunology. Pearson Education.   |           |
| <b>Reference Books</b> |   |           |
| 1                      | Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 12th edition, Wiley- Blackwell. USA.  |           |
| 2                      | Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3 <sup>rd</sup> Edition.  |           |
| 3                      | William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3 <sup>rd</sup> Edition. John Wiley and Sons Inc. New York.   |           |
| 4                      | Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4 <sup>th</sup> Edition., Wiley-Blackwell.  |           |
| 5                      | Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3 <sup>rd</sup> Edition   |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="https://www.ncbi.nlm.nih.gov/books/NBK279395/">https://www.ncbi.nlm.nih.gov/books/NBK279395/</a>   |           |
| 2                      | <a href="https://med.stanford.edu/immunol/phd-program/ebook.html">https://med.stanford.edu/immunol/phd-program/ebook.html</a>   |           |
| 3                      | <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> |           |
| 4                      | Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)   |           |
| 5                      | Immunology - an overview   Science Direct Topics  |           |

**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>  |

**Allied Paper III - BIOINSTRUMENTATION**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |             |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|-------------|
|                           |   |   |   |   |         |                     | CI A  | External | Total       |
|                           | 3   | 1 |   |   | 3       | 4                   | 25    | 75       | 100         |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |             |
| LO1                       | Practice, experiment with and apply the basic instruments in the laboratory.  |   |   |   |         |                     |       |          |             |
| LO2                       | Predict the functionality of Beer – Lambert’s law in identifying and quantifying a biomolecule.   |   |   |   |         |                     |       |          |             |
| LO3                       | Employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.  |   |   |   |         |                     |       |          |             |
| LO4                       | Understand the clinical important isotopes and detection of isotopes.   |   |   |   |         |                     |       |          |             |
| LO5                       | Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.  |   |   |   |         |                     |       |          |             |
| UNIT                      | Contents  |   |   |   |         |                     |       |          | No.of Hours |
| I                         | pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Compound, Bright field, Phase contrast and Fluorescence Microscope.   |   |   |   |         |                     |       |          | 15          |
| II                        | Spectra – Absorption and Emission Spectra – Beer Lambert’s law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance spectrometer (NMR).   |   |   |   |         |                     |       |          | 15          |
| III                       | Chromatography - Principles – Paper Chromatography, TLC, Gel filtration, Ion-Exchange, Affinity Chromatography Gas Liquid Chromatography and HPLC. Electrophoresis: Principle, Paper Electrophoresis – Cellulose Acetate Electrophoresis - Agarose Gel Electrophoresis – SDS- PAGE and Iso-electric focusing. |   |   |   |         |                     |       |          | 15          |

|                        |   |           |
|------------------------|---|-----------|
| IV                     | Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity – GM Counters, Scintillation Counters – Autoradiography – Applications. SOPs for Radioactive materials.           | 15        |
| V                      | Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge. | 15        |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Upadhyay and UpadhyayNath. (2009). “Biophysical Chemistry”, Principles and Techniques. Himalaya Publishing House.   |           |
| 2                      | L.Veerakumari, (2006) “Bioinstrumentation” MJP publishers , Kindle Edition.   |           |
| 3                      | SkoogD.A.F.James Holler and Stanky,R.Crouch, (2007) “Instrumental Methods of Analysis” Cengage Learning.  |           |
| 4                      | Palanivelu P, 2000. Analytical Biochemistry & Separation Techniques, 4th edition, Twenty first century publications.  |           |
| 5                      | Prakash M, 2009. Understanding Bioinstrumentation, 1st edition, Discovery Publishing House Pvt Ltd  |           |
| <b>Reference Books</b> |   |           |
| 1                      | Keith Wilson,John Walker,(2010).Principles and techniques of Biochemistry and Molecular Biology”(7 <sup>th</sup> edition).Cambridge University Press.   |           |
| 2                      | David L.Nelson, Michael M Cox.Lehninger(2008).”Principles of Biochemistry”,Fifth edition W.H.Freeman,Newyork.   |           |
| 3                      | Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).   |           |
| 4                      | L.A Geddes and L.E.Baker (2008) “Principles of Applied Biomedical Instrumentation”WileyIndia Third Edition.   |           |
| 5                      | Sharma B K, 2005. Instrumental Methods of Chemical Analysis, 24th Edition, GOEL Publishing House.   |           |

**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          | 3          | 3          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</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>3</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 III - IMMUNOLOGY AND IMMUNOTECHNOLOGY**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |           |                     |
|---------------------------|--|---|---|---|---------|---------------------|-------|-----------|---------------------|
|                           |  |   |   |   |         |                     | CI A  | External  | Total               |
|                           | 4  | 1 |   |   | 5       | 5                   | 25    | 75        | 100                 |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |           |                     |
| LO1                       | Perform blood grouping and determine blood type.   |   |   |   |         |                     |       |           |                     |
| LO2                       | Able to count WBC and RBC.   |   |   |   |         |                     |       |           |                     |
| LO3                       | Conduct serological diagnostic tests such as ASO, CRP, RA and Widal test.                            |   |   |   |         |                     |       |           |                     |
| LO4                       | Acquire technical skills required for immunodiffusion and know the principle behind the techniques.  |   |   |   |         |                     |       |           |                     |
| LO5                       | Able to Demonstrate ELISA, Handling of Laboratory animals.   |   |   |   |         |                     |       |           |                     |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                     |       |           | <b>No. of Hours</b> |
| 1                         | Separation of Serum and Plasma.<br>Blood grouping and Rh typing.                                     |   |   |   |         |                     |       |           | 9                   |
| II                        | WBC counting<br>RBC counting<br>Differential blood count   |   |   |   |         |                     |       |           | 9                   |
| III                       | WIDAL Slide test<br>ASO test   |   |   |   |         |                     |       |           | 9                   |
| IV                        | Double Immunodiffusion<br>Agglutination<br>Single Radial Immunodifusion                              |   |   |   |         |                     |       |           | 9                   |
| V                         | ELISA – Demonstration<br>Handling of Laboratory animals - Demonstration<br>Skin test – Demonstration |   |   |   |         |                     |       |           | 9                   |
| <b>Total</b>              |  |   |   |   |         |                     |       | <b>45</b> |                     |
| <b>Text Books</b>         |  |   |   |   |         |                     |       |           |                     |

|                        |   |
|------------------------|---|
| 1                      | Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.   |
| 2                      | Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.  |
| <b>Reference Books</b> |   |
| 1                      | Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.   |
| 2                      | Rose. (1992). Manual of Clinical Lab Immunology, ASM.   |
| 3                      | Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.   |
| 4                      | Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3 <sup>rd</sup> Edition.  |
| 5                      | Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11 <sup>th</sup> Edition., Wiley-Blackwell.  |
| <b>Web Resources</b>   |   |
| 1                      | <a href="https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual">https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual</a>                                     |
| 2                      | <a href="https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf">https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf</a> |
| 3                      | <a href="https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf">https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf</a>   |
| 4                      | Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)   |
| 5                      | Immunology - an overview   ScienceDirect Topics   |

**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          | 3          | 3          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</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>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>2.8</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

**Allied Practical III - BIOINSTRUMENTATION**

| Subject Code       | L   | T | P | S | Credits | Instructional Hours | Marks       |          |              |
|--------------------|---|---|---|---|---------|---------------------|-------------|----------|--------------|
|                    |   |   |   |   |         |                     | C<br>I<br>A | External | Total        |
|                    | 4   | 1 |   |   | 5       | 5                   | 25          | 75       | 100          |
| Learning Objective |   |   |   |   |         |                     |             |          |              |
| LO1                | Practice, experiment with and apply the basic instruments in the laboratory such as weighing balance, pH meter, shaker, incubator etc. in various research processes. |   |   |   |         |                     |             |          |              |
| LO2                | Predict the functionality of Beer – Lambert’s law in identifying and quantifying biomolecules.  |   |   |   |         |                     |             |          |              |
| LO3                | Employ the separation techniques for separating biomolecules based on paper chromatography.   |   |   |   |         |                     |             |          |              |
| LO4                | Employ the separation techniques for separating biomolecules based on Thin layer chromatography.  |   |   |   |         |                     |             |          |              |
| LO5                | Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.  |   |   |   |         |                     |             |          |              |
| UNIT               | Contents  |   |   |   |         |                     |             |          | No. of Hours |
| I                  | Preparation of Buffer (Phosphate Buffer)<br>Determination of pH of biological samples using pH meter  |   |   |   |         |                     |             |          | 9            |
| II                 | UV spectra of Nucleic acids and proteins.   |   |   |   |         |                     |             |          | 9            |
| III                | Chromatography analysis of sugar, amino acids by paper chromatography.  |   |   |   |         |                     |             |          | 9            |
| IV                 | Chromatography analysis of sugar, amino acids by Thin layer chromatography.   |   |   |   |         |                     |             |          | 9            |
| V                  | Fractionation of biological material into its various components by Centrifuge.   |   |   |   |         |                     |             |          | 9            |
| Total              |   |   |   |   |         |                     |             | 45       |              |

| Text Books      |   |
|-----------------|---|
| 1               | Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology.2018   |
| 2               | Bhomwik (2011), <i>Analytical techniques in Biotechnology – A complete laboratory manual</i> , MGH Publisher, ISBN-13 : 978-0070700130  |
| Reference Books |   |
| 1               | P. Palanivelu (2017), <i>Analytical Biochemistry and Separation techniques – A laboratory manual</i> , (5 <sup>th</sup> Edition), Twentyfirst century publishers, ISBN: 978-81-908489-0-9 |

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

|                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 |
|----------------|-----|-----|-----|-----|-----|-----|------|------|------|
| <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   | 3   | 3   | 3   | 3   | 3    | 2    | 3    |
| <b>TOTAL</b>   | 15  | 15  | 15  | 15  | 14  | 14  | 15   | 14   | 14   |
| <b>AVERAGE</b> | 3   | 3   | 3   | 3   | 2.8 | 2.8 | 3    | 2.8  | 2.8  |

**SKILL ENHANCEMENT- 4****HERBAL MEDICINE**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |  |   |   |   |         |                     | CI A  | External | Total               |
|                           | 4  | 1 |   |   | 5       | 5                   | 25    | 75       | 100                 |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |                     |
| LO1                       | The student can analyses the importance of herbal medicine   |   |   |   |         |                     |       |          |                     |
| LO2                       | can learn the role of herbal medicines for health  |   |   |   |         |                     |       |          |                     |
| LO3                       | Can explain about Tribal medicine  |   |   |   |         |                     |       |          |                     |
| LO4                       | can analyses the role of traditional medicine for today's health   |   |   |   |         |                     |       |          |                     |
| LO5                       | can demonstrate the use of medicinal herbs to health   |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| I                         | Ethnomedicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.   |   |   |   |         |                     |       |          | 15                  |
| II                        | Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).  |   |   |   |         |                     |       |          | 15                  |
| III                       | Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion – <i>Aegle marmelos</i> , <i>Ficus benghalensis</i> , <i>Curcuma domestica</i> , <i>Cynodon dactylon</i> and <i>Sesamum indicum</i> .   |   |   |   |         |                     |       |          | 15                  |
| IV                        | Traditional knowledge and utility of some medicinal plants in Tamil Nadu – <i>Solanum trilobatum</i> , <i>Cardiospermum halicacabum</i> , <i>Vitex negundo</i> , <i>Azadirachta indica</i> , <i>Gloriosa superba</i> , <i>Eclipta alba</i> , <i>Aristolochia indica</i> and <i>Phyllanthus fraternus</i> . |   |   |   |         |                     |       |          | 15                  |

|                        |   |    |
|------------------------|---|----|
| V                      | Plants in day today life – <i>Ocimum sanctum</i> , <i>Centella asiatica</i> , <i>Cassia auriculata</i> , <i>Aloe vera</i> . Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and Vegetables - Greens (Moringa, <i>Solanum nigrum</i> Cabbage). | 15 |
| Total                  |   | 75 |
| <b>Text Books</b>      |   |    |
| 1                      | R.K.Sinha&ShwetaSinha (2001), Ethnobiology. Surabhe Publications – Jaipur.  |    |
| 2                      | D.C. Pal & S.K. Jain NayaPrakash, (1998), Tribal medicine, BidhanSarani, Calcutta ,   |    |
| 3                      | S.K. Jain (2001) Contribution to Indian Ethnobotany – S.K. Jain, 3rd edition, scientificpublishers, B.No.91, Jodhpur, India.  |    |
| 4                      | Andrew Chevallie, (2000) Encyclopedia of Herbal Medicine  |    |
| 5                      | James Green (2000). The Herbal Medicine-Maker's Handbook: A Home Manual   |    |
| <b>Reference Books</b> |   |    |
| 1                      | <b>Steven Horne and Thomas Easley (2016), Modern Herbal Dispensatory: A MedicineMaking Guide</b>  |    |
| 2                      | <b>M.C. Joshi (2007) Handbook of Indian Medicinal Plants Hardcover.</b>   |    |
| 3                      | Neelesh Malviya and Sapna Malviya (2019). <i>Herbal Drug Technology</i> , (1st Edition), CBS Publishers and Distributors, ISBN: 9789387964334.  |    |
| 4                      | Rageeb Md. Usman, Vaibhav M. Darvhekar, Vijay Kumar D, and Akhila S.A, (2019). <i>Practical Book of Herbal Drug Technology</i> , (1st Edition), Nirali Prakashan Publishers, ISBN: 9789388108002.   |    |
| 5                      | Pragi and Varun Arora (2019). <i>Herbal Drug Technology</i> , (1st Edition), S.Vikas and Company Publisher, ISBN: 9781543343687   |    |

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

|             | PO1      | PO2      | PO3      | PO4      | PO5      | PO6      | PSO1     | PSO2     | PSO3     |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>CLO1</b> | <b>3</b> | <b>2</b> | <b>-</b> | <b>1</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> |
| <b>CLO2</b> | <b>3</b> | <b>2</b> | <b>-</b> | <b>1</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> |
| <b>CLO3</b> | <b>3</b> | <b>2</b> | <b>-</b> | <b>2</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> |

|                |           |           |            |            |           |           |           |           |           |
|----------------|-----------|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|
| <b>CLO4</b>    | <b>3</b>  | <b>2</b>  | <b>2</b>   | <b>2</b>   | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  |
| <b>CLO5</b>    | <b>3</b>  | <b>2</b>  | <b>2</b>   | <b>2</b>   | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  |
| <b>TOTAL</b>   | <b>15</b> | <b>10</b> | <b>4</b>   | <b>8</b>   | <b>15</b> | <b>15</b> | <b>15</b> | <b>15</b> | <b>15</b> |
| <b>Average</b> | <b>3</b>  | <b>2</b>  | <b>0.8</b> | <b>1.6</b> | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>3</b>  |

## **SKILL ENHANCEMENT -5 MUSHROOM CULTIVATION**

### **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.

### **Unit – II:**

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

### **Unit – III:**

Life cycle of *Pleurotus* spp and *Agaricus* spp.

### **Unit – IV:**

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

### **Unit – V:**

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

### **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.

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

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|--------------|
|                           |  |   |   |   |         |                     | CI A  | External | Total        |
|                           | 5  | 1 |   |   | 5       | 6                   | 25    | 75       | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |              |
| LO1                       | Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.   |   |   |   |         |                     |       |          |              |
| LO2                       | Enumerate various recombinant techniques and gene probes and molecular markers identification.   |   |   |   |         |                     |       |          |              |
| LO3                       | Understand Gene transfer techniques by Viral and Nonviral mediated gene transfer mechanisms.   |   |   |   |         |                     |       |          |              |
| LO4                       | Exhibit knowledge in sequencing technologies and protein engineering techniques.   |   |   |   |         |                     |       |          |              |
| LO5                       | Explore the strategies of Recombinant DNA Technology in r medicine, Industry and agriculture.  |   |   |   |         |                     |       |          |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |          | No. of Hours |
| I                         | Genetic Engineering – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies (enzymes, vectors, host) – introduction of rDNA into host cells.  |   |   |   |         |                     |       |          | 15           |
| II                        | Identification of recombinants, selection and screening for Recombinants. DNA sequencing – Construction of Genomic DNA library and cDNA library). Human Genome Project. Polymerase Chain reaction- Methodology and its Types.  |   |   |   |         |                     |       |          | 15           |
| III                       | Gene transfer techniques – Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer - Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes. |   |   |   |         |                     |       |          | 15           |
| IV                        | Gene Expression – Expression system and their applications - protein based products – Protein engineering– production of protein from cloned genes. Site directed Mutagenesis, Restriction Fragment Length Polymorphism (RFLP).  |   |   |   |         |                     |       |          | 15           |
| V                         | Application of Recombinant DNA technology in medicine, industry,   |   |   |   |         |                     |       |          | 15           |

|                        |   |           |
|------------------------|---|-----------|
|                        | agriculture and r-DNA technology - merits and demerits.   |           |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.  |           |
| 2                      | Desmond S.T. Nicholl, 2008. An Introduction to Genetic Engineering, 3rd edition, Cambridge university press.                                |           |
| 3                      | R.W. Old & S.B. Primrose, Principles of Gene Manipulation, Fifth Edition, Blackwell Science.  |           |
| 4                      | Genetic Engineering Principles and Methods by Setlow, Jane K. (Volume 24).  |           |
| 5                      | Keya Chaudhuri, 2012. Recombinant DNA Technology.   |           |
| <b>Reference Books</b> |   |           |
| 1                      | David Clark Nanette Pazdernik Michelle McGehee (2018), <i>Molecular Biology techniques</i> , ( 3 <sup>rd</sup> edition).                    |           |
| 2                      | <u>Anton Byron</u> (2019), <i>Introduction to Gene Cloning</i> , Publisher: Oxford Book Company   |           |
| 3                      | Monika Jain (2012), <i>Recombinant DNA technology</i> , (I edition), Alpha Science International. ISBN-13 : 978-1842656679.                 |           |
| 4                      | Primrose.S.B (2014), <i>Principles of gene manipulation</i> , (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3 |           |
| <b>Web Resource</b>    |   |           |
| 1                      | <a href="https://www.britannica.com/recombinant-DNA-technology">https://www.britannica.com/recombinant-DNA-technology</a>                   |           |
| 2                      | <a href="https://www.le.ac.uk/recombinant-dna-and-genetic-techniques">https://www.le.ac.uk/recombinant-dna-and-genetic-techniques</a>       |           |
| 3                      | <a href="https://www..ncbi.nlm.nih.gov">https://www..ncbi.nlm.nih.gov</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          | 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          | 3          | 3          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</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>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>2.8</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

**Allied Paper IV - BIOINFORMATICS AND BIostatISTICS**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |  |   |   |   |         |                     | CI A  | External | Total               |
|                           | 3  | 1 |   |   | 3       | 4                   | 25    | 75       | 100                 |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |                     |
| LO1                       | Acquire knowledge about the Developments and Applications of Bioinformatics.   |   |   |   |         |                     |       |          |                     |
| LO2                       | Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.  |   |   |   |         |                     |       |          |                     |
| LO3                       | Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.  |   |   |   |         |                     |       |          |                     |
| LO4                       | Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency  |   |   |   |         |                     |       |          |                     |
| LO5                       | Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.  |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| 1                         | Introduction to Bioinformatics – Genome, Transcriptome and Proteome, Gene prediction rules and software. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – CATH, SCOP – Data base Searching – BLAST and FASTA.   |   |   |   |         |                     |       |          | 15                  |
| II                        | Sequence analysis (Proteins and Nucleic acids), Protein Database: Comparison of Protein sequences and Database searching – methods for protein structure prediction - Homology modeling of proteins, visualization tools (RASMOL).   |   |   |   |         |                     |       |          | 15                  |
| III                       | Multiple Sequences alignment – method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenetic trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Drug design |   |   |   |         |                     |       |          | 15                  |
| IV                        | Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency – measures of dispersion.   |   |   |   |         |                     |       |          | 15                  |
| V                         | Probability distribution-Binomial, Negative binomial, multinomial  |   |   |   |         |                     |       |          | 15                  |

|                        |   |           |
|------------------------|---|-----------|
|                        | distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Soft wares. |           |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Pennington, S.R. and Punn, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pvt. Ltd.                                       |           |
| 2                      | Shuba G., 2010. Bioinformatics., Tata McGraw Hill publishing. India.  |           |
| 3                      | Rastogi, S.C, Mendiratta, N, Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.      |           |
| 4                      | N.Gurumani (2011) "An Introduction to Biostatistics" MJP Publishers   |           |
| 5                      | Verbala Rastogi .(2011). "Fundamentals of Biostatistics", Ane books Pvt Ltd Publishers, Chennai.  |           |
| <b>Reference Books</b> |   |           |
| 1                      | Attwood, T.K. and Parry-Smith, D.J. 2008. Introduction to Bioinformatics. Pearson Education.  |           |
| 2                      | David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.  |           |
| 3                      | D.R. Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.   |           |
| 4                      | Zar, (J.H. 2010). "Biostatistical Analysis" Fifth Edition, Pearson Education Pvt Ltd, Indian Branch, New Delhi.                                 |           |
| 5                      | P.N. Arora and P.K. Malhan. (2013) "Biostatistics" Himalaya publishing House.   |           |

**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> | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <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>3</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>15</b> | <b>14</b>  | <b>14</b>  | <b>15</b> | <b>15</b> | <b>14</b>  | <b>14</b>  |
| <b>AVERAGE</b> | <b>3</b>  | <b>3</b>  | <b>3</b>  | <b>2.8</b> | <b>2.8</b> | <b>3</b>  | <b>3</b>  | <b>2.8</b> | <b>2.8</b> |

**Core Practical IV- GENETIC ENGINEERING**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks     |                     |       |
|---------------------------|---|---|---|---|---------|---------------------|-----------|---------------------|-------|
|                           |   |   |   |   |         |                     | CIA       | External            | Total |
|                           | 4   | 1 |   |   | 5       | 5                   | 25        | 75                  | 100   |
| <b>Learning Objective</b> |   |   |   |   |         |                     |           |                     |       |
| <b>LO1</b>                | <b>Isolate the Plasmid DNA and Genomic DNA. and predict the molecular weight of DNA by agarose gel electrophoresis.</b> |   |   |   |         |                     |           |                     |       |
| <b>LO2</b>                | <b>Demonstrate working principles of PCR, RFLP and other important Genetic Engineering techniques.</b>                  |   |   |   |         |                     |           |                     |       |
| <b>LO3</b>                | <b>Prepare the competent cells and perform bacterial transformation.</b>  |   |   |   |         |                     |           |                     |       |
| <b>LO4</b>                | <b>Determine the restriction digestion of DNA</b>   |   |   |   |         |                     |           |                     |       |
| <b>LO5</b>                | <b>Determine the restriction fragment length polymorphism.</b>  |   |   |   |         |                     |           |                     |       |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |           | <b>No. of Hours</b> |       |
| 1                         | Isolation of genomic DNA<br>Isolation of plasmid DNA  |   |   |   |         |                     |           | 9                   |       |
| II                        | Isolation of RNA  |   |   |   |         |                     |           | 9                   |       |
| III                       | Production of competent cells for transformation<br>Bacterial transformation  |   |   |   |         |                     |           | 9                   |       |
| IV                        | Restriction Digestion of DNA  |   |   |   |         |                     |           | 9                   |       |
| V                         | Restriction Fragment Length Polymorphism(DEMO)<br>PCR(Demonstration)  |   |   |   |         |                     |           | 9                   |       |
| <b>Total</b>              |   |   |   |   |         |                     | <b>45</b> |                     |       |
| <b>Text Books</b>         |   |   |   |   |         |                     |           |                     |       |
| <b>1</b>                  | <b>Laboratory Manual for GENETIC ENGINEERING 1st Edition, Kindle Edition by S. JOHN VENNISON (Author) 2009.</b>         |   |   |   |         |                     |           |                     |       |

**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          | 3          | 3          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | 15         | 15         | 15         | 14         | 14         | 14         | 15          | 14          | 14          |
| <b>AVERAGE</b> | 3          | 3          | 3          | 2.8        | 2.8        | 2.8        | 3           | 2.8         | 2.8         |

**Allied Practical IV- BIOINFORMATICS AND BIostatISTICS**

| 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                       | Analyse the Biological databases   |   |   |   |         |                     |       |           |              |
| LO2                       | Able to perform BLAST and FASTA  |   |   |   |         |                     |       |           |              |
| LO3                       | Represent data in to graphical form  |   |   |   |         |                     |       |           |              |
| LO4                       | Test the level of significance of biological data and interpret the results.   |   |   |   |         |                     |       |           |              |
| LO5                       | Determine averages of the biological data  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |           | No. of Hours |
| I                         | Biological databases (NCBI, Swissprot and PDB)   |   |   |   |         |                     |       |           | 9            |
| II                        | BLAST FASTA  |   |   |   |         |                     |       |           | 9            |
| III                       | Identification of functional domains in nucleotide binding proteins using a domain analysis server like SMART  |   |   |   |         |                     |       |           | 9            |
| IV                        | Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.<br>Calculation of Central tendency- mean, geometric mean, median using MS EXCEL |   |   |   |         |                     |       |           | 9            |
| V                         | Calculation of dispersion – standard deviation using MS EXCEL<br>Calculation of student's t test using MS EXCEL  |   |   |   |         |                     |       |           | 9            |
| <b>Total</b>              |  |   |   |   |         |                     |       | <b>45</b> |              |
| <b>Text Books</b>         |  |   |   |   |         |                     |       |           |              |
| 1                         | Pennington, S.R. and Punn, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pri. Ltd.  |   |   |   |         |                     |       |           |              |
| 2                         | Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd   |   |   |   |         |                     |       |           |              |
| 3                         | Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols.   |   |   |   |         |                     |       |           |              |

|                        |  |
|------------------------|--|
|                        | Humana press.  |
| <b>4</b>               | Attwood, T.K. and Parry-Smith, D.J.1999. Introduction to Bioinformatics. Pearson Education Asia.   |
| <b>5</b>               | Primrose, S.B. 1998. Principle of genome analysis. 2ndedition. Blackwell Science.  |
| <b>Reference Books</b> |  |
| <b>1</b>               | Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.                          |
| <b>2</b>               | Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.        |
| <b>Web Resources</b>   |  |
| <b>1</b>               | Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne |
| <b>2</b>               | Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York                  |

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

|                 | <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>     | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>     | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <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>2</b>    | <b>3</b>    |
| <b>TOTAL</b>    | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>14</b>  | <b>14</b>  | <b>14</b>  | <b>15</b>   | <b>14</b>   | <b>14</b>   |
| <b>AVERAG E</b> | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

**SKILL ENHANCEMENT-6****FOOD AND NUTRITION**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |   |   |   |   |         |                     | CI A  | External | Total               |
|                           |   |   |   |   |         |                     | 25    | 75       | 100                 |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                     |
| <b>LO1</b>                | <b>The student can determine the relationship between food , health and immunity</b>  |   |   |   |         |                     |       |          |                     |
| <b>LO2</b>                | <b>Able to explain the classification of foods and their deficiency</b>   |   |   |   |         |                     |       |          |                     |
| <b>LO3</b>                | <b>Can analyse the importance of BMR</b>  |   |   |   |         |                     |       |          |                     |
| <b>LO4</b>                | <b>Can outline the basic food groups and their adulteration</b>   |   |   |   |         |                     |       |          |                     |
| <b>LO5</b>                | <b>Apply the concepts of food to prepare different food plans</b>   |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| 1                         | Definition of food, Nutrition, Nutrient, Nutritional status, Dietetics, Balance diet, Malnutrition, Energy (Unit of energy-Joule, Kilocalorie). Health, Immunity by food and function of food.  |   |   |   |         |                     |       |          | 15                  |
| II                        | Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine) -Sources, Classification, Function, Deficiencies of these nutrients. Function of water and dietary fiber.                  |   |   |   |         |                     |       |          | 15                  |
| III                       | BMR: Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals)   |   |   |   |         |                     |       |          | 15                  |
| IV                        | Basic five food groups, nutritional significance of cereals, pulses, milk, meat, fish, vegetables, egg, nuts, oils and sugars. Food toxins, Food additives, Food quality, Safe food handling, Food adulteration, Preservatives and Packaging. |   |   |   |         |                     |       |          | 15                  |
| V                         | Principles and Objectives of meal planning. Diet for an infant, preschool child, School child, normal male and female of different occupations.   |   |   |   |         |                     |       |          | 15                  |

|                        |  |           |
|------------------------|--|-----------|
| <b>Total</b>           |  | <b>75</b> |
| <b>Text Books</b>      |  |           |
| 1                      | Vidya & D.B. Rao, 2010. A textbook of nutrition by, Discovery Publishing house,  |           |
| 2                      | Handbook of Nutrition & Food, third edition, CRC Press (Taylor and Francis group) by Carolyn D.Berdanier   |           |
| 3                      | Food science and Nutrition, Oxford publication by Sunetra Roday  |           |
| 4                      | Janet D Ward & Larry T Ward, Principles of food science by, Good heart-Wilcox publishing.  |           |
| 5                      | Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press.   |           |
| <b>Reference Books</b> |  |           |
| 1                      | Joshi, V.K. and Singh, R.S., A. (2013), <i>Food Biotechnology- Principles and practices</i> , I.K.International Publishing House Pvt. Ltd., New Delhi,.                    |           |
| 2                      | RavishankarRai, V,( 2015), <i>Advances in Food Biotechnology</i> , (First edition), John Wiley & Sons, Inc, ISBN 9781118864555   |           |
| 3                      | Foster, G.N., (2020), <i>Food Biotechnology</i> , ( First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348  |           |
| 4                      | Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin (2005), <i>Food Biotechnology</i> , (2 <sup>nd</sup> edition), <i>CRC Press</i> , ISBN 9780824753290 |           |
| 5                      | Perry Johnson-Green (2018), <i>Introduction to Food Biotechnology</i> , Special Indian Edition, <i>CRC Press</i> , ISBN 9781315275703                                      |           |

**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          | 1          | 3          | 2          | 3           | 3           | 3           |
| <b>CLO2</b> | 3          | 2          | 1          | 1          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO3</b> | 3          | 2          | 1          | 1          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO4</b> | 3          | 2          | 1          | 1          | 3          | 3          | 3           | 3           | 3           |

|                |           |           |          |          |           |            |           |           |           |
|----------------|-----------|-----------|----------|----------|-----------|------------|-----------|-----------|-----------|
| <b>CLO5</b>    | <b>3</b>  | <b>2</b>  | <b>1</b> | <b>1</b> | <b>3</b>  | <b>3</b>   | <b>3</b>  | <b>3</b>  | <b>3</b>  |
| <b>TOTAL</b>   | <b>15</b> | <b>10</b> | <b>5</b> | <b>5</b> | <b>15</b> | <b>14</b>  | <b>15</b> | <b>15</b> | <b>15</b> |
| <b>Average</b> | <b>3</b>  | <b>2</b>  | <b>1</b> | <b>1</b> | <b>3</b>  | <b>2.8</b> | <b>3</b>  | <b>3</b>  | <b>3</b>  |

## **SKILL ENHANCEMENT-7**

### **AQUACULTURE**

#### **Course outcome:**

Students will be able to understand aquaculture systems, conditioning factors, fish feeding behaviour and breeding and rearing techniques.

#### **Unit – I:**

Aquaculture-Global scenario, Origins and growth of aquaculture, Present status in India and Tamil Nadu; Fish pond construction- site selection; types of ponds, water quality analyses, liming and fertilization, morphology and commercial characteristics of cultivable fishes, culture practice, predator fishes, weed fishes control, Sources of pollution, Environmental impacts.

#### **Unit – II:**

Fin fish culture - Composite fish culture (Indian Major Carps and Murrels); Sewage fed fish culture and integrated fish culture, Marine water fish culture. Shellfish and seaweed culture - Culture of marine prawns, edible and pearl oysters, adaptive management; Seaweeds- types and their culture practices.

#### **Unit – III:**

Live feed organisms – Artemia and rotifers culture; Fish feed - types, formulation and preparation, techniques, Consequences of artificial feeding; Natural, supplementary and artificial breeding; Breeding – Bundh breeding and induced breeding; rearing of hatchlings, fry and fingerlings.

#### **Unit – IV:**

Fungus infections. Protozoan diseases. Worm diseases. Non parasitic diseases. Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.

#### **Unit – V:**

Applied aquaculture: Identification of cultivable fish species; Morphometry of pond (Enclosed rectangular method/Shore length/ shore area and shore line development).Fishing technology (crafts and gears). Home aquarium and agency involved in aquaculture.

#### **References:**

1. Biswas, K. P. 2000. Prevention and control of fish and prawn diseases. Narendra publishing house, New Delhi.
2. Hute, M. and Kahn, H. (2000) Textbook of fish culture, Blackwell Scientific Publication, Australia.
3. Ninawe, A. S and Khadkar, G. D. 2009. Nutrition in Aquaculture, First Edition, Narendra publishing House, New Delhi.
4. Jameson, J.D. and Santhanam. R. 1996, Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.
5. Jhingran, V.G. 1997. Fish and Fisheries of India. Hindustan Publishers, New Delhi.
6. Srinivasulu, M., Reddy, K.R.S., Rao, S. (1999) Text book of Aquaculture, Discovery Publishing House New Delhi

