

# Curriculum for B. Sc Biotechnology

## Bachelor of Science

### B. Sc SYLLABUS

*[For the Candidates admitted on 2023-2026 onwards under Autonomous, CBCS & OBE pattern]*

(I to IV SEMESTERS)



## DEPARTMENT OF BIOTECHNOLOGY



## VIVEKANANDHA

### COLLEGE OF ARTS AND SCIENCES FOR WOMEN

**[AUTONOMOUS]**

An ISO 9001:2015 Certified Institution | Affiliated to Periyar University  
Approved by AICTE | Re-accredited with "A" Grade by NAAC|  
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.  
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

## **Preamble**

Biotechnology is an area of biology that uses living processes, organisms or systems to manufacture products or technology intended to improve the quality of human life. It is an integrated science with interdisciplinary knowledge of biochemistry, Molecular Biology, Microbiology, Genetics, Plant and Animal sciences, Environmental and Pharmaceutical sciences.

Biotechnology has the potential to bring a tremendous change in the socio-economic status of the people by creating a positive impact with food security, Animal husbandry, fisheries, assurance of quality food products to the consumers, environmental protection, health care etc.

The Biotechnology course has the opportunities in health care sector and diagnostics, Research with Institutes, Universities, Animal health, Vaccine industry, Agriculture, Food technology, Pharmaceutical industry, Industrial and Environmental Sciences, Bioinformatics, Biosafety and Education.

The syllabus of Biotechnology is framed in such a way so as to give a fundamental understanding in the different inter disciplinary areas of Cell Biology, Biochemistry, Microbiology, Genetics, Immunology, Animal and Plant Science, Environmental and Pharmaceutical sciences.

The practical syllabus has been designed to enable the students to link and support with their theory background. This also imparts the knowledge of handling instruments and the understanding of interdisciplinary facet of Biotechnology.

The syllabus is also equipped with Entrepreneurial development to help students to start their own enterprises as job providers, which will instill confidence, and to make smarter plans for future development.

### **Aim of the Programme:**

The aim of the programme is to provide students with a wide knowledge in different areas of Biotechnology and to prepare them for employment and research in this rapidly growing field. This programme enables the students with innovative ideas for business creation, creating job opportunities,

and the importance of entrepreneurship for facing the challenges and to improve the economy of the nation.

**Nature and extent of the Programme:**

The field of Biotechnology is an interdisciplinary science and is growing at a tremendous rate with application in medicine, agriculture, environment and nanotechnology. This tremendous growth is because of the integration of new technologies in biological research.

New upcoming thrust areas like Marine Biotechnology, Research Methodology, Bio entrepreneurship and Nanotechnology is introduced in this programme. The programme also offers students the freedom to choose the electives based on their preferences. This will help the students to start, grow their own enterprises and make smarter plans for future development.

**Graduate attributes:**

The graduate after completing the course becomes a full-fledged Bio entrepreneur with a complete understanding of the various concepts of Biotechnology. This course is designed in such a way as to kindle creative thinking abilities with problem solving capacity and also research attitude. This programme will enable the students to be self-employed, and bring constructive changes to their professional life, work place and to the community at large.

| <b>LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES<br/>BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME</b> |  |
|---|--|
| <b>Programme:</b>   | B.Sc. BIOTECHNOLOGY  |
| <b>Programme Code:</b>  |  |
| <b>Duration:</b>  | 3 Years [UG]   |
| <b>Programme Outcomes:</b>  | <b>PO1:</b> Students understand the major concepts in Biology and understand the fundamental principles. |

|  |  |
|--|--|
|  | <p><b>PO2:</b> Students will develop scientific outlook not only with respect to life science, but in all aspects related to life.</p>   |
|  | <p><b>PO3:</b> Students are trained to apply and adapt appropriate techniques, resources, and instrumentation which will help them to pursue higher education or jobs after the programme.</p> |
|  | <p><b>PO4:</b> Students develop the ability to effectively communicate scientific information with strong ethics in written and oral formats.</p>  |
|  | <p><b>PO5:</b> Students will understand their roles and responsibilities especially the protection of the people.</p>  |
|  | <p><b>PO6:</b> Students become eligible to pursue higher education in their respective fields and engage in lifelong learning and enduring proficient progress.</p>                            |
| <p><b>Programme Specific Outcomes:</b></p> | <p><b>PSO1:</b> Recall the fundamentals of Biotechnology which would enable them to comprehend the emerging and advanced biotechnology concepts in life sciences.</p>                          |
|  | <p><b>PSO2:</b> Inculcate deeper knowledge in practical skills enabling them to work with disciplinary and interdisciplinary aspects of biotechnology.</p>                                     |
|  | <p><b>PSO3:</b> Enhance students' learning abilities, technological solutions in domains of biotechnology for their applications in industry and research and entrepreneurial skills.</p>      |
|  | <p><b>PSO4:</b> Evaluate the need and impact of scientific techniques on the environment and the society, keeping in view their sustainable development.</p>                                   |
|  | <p><b>PSO5:</b> Analyze the knowledge gained in Biotechnology for lifelong learning.</p>   |

## FIRST SEMESTER

| Course Content | Paper Code | Name of the Course  | Ins. Hrs  | Credits   | Int. Marks | Ext. Marks | Total      |
|----------------|------------|---|-----------|-----------|------------|------------|------------|
| Part – I       | 22U1LT01   | Language Paper – I  | 4         | 3         | 25         | 75         | 100        |
| Part - II      | 22U1CE01   | English Paper – I   | 4         | 3         | 25         | 75         | 100        |
| Part III       | 23U1BTC01  | Core Paper I -<br>Cell andMolecular Developmental<br>Biology          | 5         | 5         | 25         | 75         | 100        |
|                | 23U1BTCP01 | Core Practical I –<br>Cell andMolecular Developmental<br>Biology      | 4         | 2         | 40         | 60         | 100        |
|                | 23U1BTA01  | Allied Paper I –<br>Biological Chemistry                              | 4         | 3         | 25         | 75         | 100        |
|                | 23U1BTAP01 | Allied Practical I –<br>Biological Chemistry                          | 4         | 2         | 40         | 60         | 100        |
| Part IV        | 23U1BTN01  | *Basic Tamil/Adv.<br>Tamil/Non - Major Elective<br>Food and Nutrition | 2         | 2         | 25         | 75         | 100        |
|                | 23U1BTN02  | Herbal Medicine   |           |           |            |            |            |
|                | 23U1BTN03  | Public Health and Hygiene   |           |           |            |            |            |
|                | 23U1BTN04  | Environment Management in<br>Industries                               |           |           |            |            |            |
|                | 23U1BTSS01 | Soft skill – I<br>Basic in Lab Safety                                 | 3         | 3         | 25         | 75         | 100        |
|                |            | <b>Total</b>  | <b>30</b> | <b>23</b> | <b>230</b> | <b>570</b> | <b>800</b> |

**\* Non major elective: Choose any one from the other department**

**Theory : 06**

**Practical : 02 (4hrs)**

## SECOND SEMESTER

| Course Content | Paper Code | Name of the Course   | Ins. Hrs  | Credits   | Int. Marks | Ext. Marks | Total      |
|----------------|------------|--|-----------|-----------|------------|------------|------------|
| Part – I       | 22U2LT02   | Language Paper – II  | 4         | 3         | 25         | 75         | 100        |
| Part - II      | 22U2CE02   | English Paper – II   | 4         | 3         | 25         | 75         | 100        |
| Part - III     | 23U2BTC02  | Core Paper II – Genetics   | 5         | 5         | 25         | 75         | 100        |
|                | 23U2BTCP02 | Core Practical II – Genetics   | 4         | 2         | 40         | 60         | 100        |
|                | 23U2BTA02  | Allied Paper II - Fundamentals of Microbiology                               | 4         | 3         | 25         | 75         | 100        |
|                | 23U2BTAP02 | Allied Practical II - Fundamentals of Microbiology                           | 4         | 2         | 40         | 60         | 100        |
| Part IV        | 23U2BTN02  | Basic Tamil/Adv. Tamil/ Non - Major Elective Good Laboratory Practices (GLP) | 2         | 2         | 25         | 75         | 100        |
|                | 23U2BTN06  | Organic Farming and Health Management  |           |           |            |            |            |
|                | 23U2BTN07  | Biotechnology For Society  |           |           |            |            |            |
|                | 23U2BTN08  | Computational Biology  |           |           |            |            |            |
|                | 23U2BTSS02 | Soft skill – II Basic Calculation in Biology                                 | 3         | 3         | 25         | 75         | 100        |
|                |            | <b>Total</b>   | <b>30</b> | <b>23</b> | <b>230</b> | <b>570</b> | <b>800</b> |

**\* Non major elective: Choose any one from the other department**

**Theory : 06**

**Practical : 02 (4hrs)**

### THIRD SEMESTER

| Course Content | Paper Code  | Name of the Course                                   | Ins. Hrs  | Credits   | Int. Marks | Ext. Marks | Total      |
|----------------|-------------|--|-----------|-----------|------------|------------|------------|
| Part – I       | 22U3LT03    | Language Paper – III                                 | 4         | 3         | 25         | 75         | 100        |
| Part – II      | 22U3CE03    | English Paper – III                                  | 4         | 3         | 25         | 75         | 100        |
| Part – III     | 23U3BTC03   | Core Paper III – Immunology and Immunotechnology     | 5         | 5         | 25         | 75         | 100        |
|                | 23U3BTCP03  | Core Practical III – Immunology and Immunotechnology | 4         | 2         | 40         | 60         | 100        |
|                | 23U3BTA03   | Allied Paper III– Bioinstrumentation                 | 4         | 3         | 25         | 75         | 100        |
|                | 23U3BTAP03  | Allied Practical II– Bioinstrumentation              | 4         | 2         | 40         | 60         | 100        |
| PART IV        | 23U3BTSSP03 | Soft Skill- III Computer in Biology                  | 3         | 3         | 40         | 60         | 100        |
|                | 23U3BTVE01  | Environmental Studies                                | 1         | 0         | -          | -          | -          |
|                |             | Library  | 1         | 0         | -          | -          | -          |
| <b>Total</b>   |             |  | <b>30</b> | <b>21</b> | <b>220</b> | <b>480</b> | <b>700</b> |

- Examination will be held in IV Semester

**Theory : 04**  
**Practical : Core practicals (4hrs)**  
**Soft Skill (3hrs)**

### FOURTH SEMESTER

| Course Content | Paper Code | Name of the Course  | Ins. Hrs | Credits | Int. Marks | Ext. Marks | Total |
|----------------|------------|---|----------|---------|------------|------------|-------|
| Part – I       | 22U4LT04   | Language Paper – IV   | 4        | 3       | 25         | 75         | 100   |
| Part - II      | 22U4CE04   | English Paper – IV  | 4        | 3       | 25         | 75         | 100   |
| Part - III     | 23U4BTC04  | Core Paper IV – Genetic Engineering and rDNA Technology     | 6        | 5       | 25         | 75         | 100   |
|                | 23U4BTCP04 | Core Practical IV - Genetic Engineering and rDNA Technology | 4        | 2       | 40         | 60         | 100   |
|                | 23U4BTA04  | Allied Paper IV - Bioinformatics and Biostatistics          | 4        | 3       | 25         | 75         | 100   |

|                |             |  |           |           |            |            |            |
|----------------|-------------|--|-----------|-----------|------------|------------|------------|
|                | 23U4BTAP04  | Allied Practical IV -<br>Bioinformatics and<br>Biostatistics | 4         | 2         | 40         | 60         | 100        |
| <b>Part-IV</b> | 23U4BTSDC01 | Skill Development<br>Course Genome Editing                   | 2         | 2         | 25         | 75         | 100        |
|                | 23U4BTVE02  | Environmental Studies  | 1         | 2         | 25         | 75         | 100        |
|                |             | Library  | 1         | 0         | -          | -          | -          |
|                |             | <b>Total</b>   | <b>30</b> | <b>22</b> | <b>230</b> | <b>570</b> | <b>800</b> |

**Theory : 06**  
**Practical : 02 (4hrs)**

### FIFTH SEMESTER

| Course Content | Paper Code                                       | Name of the Course  | Ins. Hrs  | Credits   | Int. Marks | Ext. Marks | Total      |
|----------------|--|---|-----------|-----------|------------|------------|------------|
| Part - III     | 23U5BTC05  | Core Paper V –<br>Plant Biotechnology   | 5         | 5         | 25         | 75         | 100        |
|                | 23U5BTC06  | Core Paper VI –<br>Animal Biotechnology   | 5         | 5         | 25         | 75         | 100        |
|                | 23U5BTC07  | Core Paper VII –<br>Environmental<br>and Industrial Biotechnology                               | 6         | 5         | 25         | 75         | 100        |
|                | 23U5BTE01<br>23U5BTE02<br>23U5BTE03<br>23U5BTE04 | * Elective I –<br>Nano Biotechnology<br>Enzymology<br>Bioethics and Biosafety<br>Cancer Biology | 4         | 4         | 25         | 75         | 100        |
|                | 23U5BTCP05                                       | Core Practical V –<br>Plant Biotechnology<br>And Animal Biotechnology                           | 4         | 2         | 40         | 60         | 100        |
|                | 23U5BTCP06                                       | Core Practical VI –<br>Environmental and Industrial<br>Biotechnology                            | 4         | 2         | 40         | 60         | 100        |
| Part- IV       | 23U5BTINT01                                      | Internship  | -         | 2         | -          | -          | -          |
| Part- V        | 23U5BTVE01                                       | Value Education   | 1         | 2         | 25         | 75         | 100        |
| Part VI        | 23U5BTSDC02                                      | Skill development Course<br>(Preparation for Exams)<br>IIT, JAN, AIIMS, GATE& TIFR              | 1         | 1         | 25         | 75         | 100        |
|                |  | <b>Total</b>  | <b>30</b> | <b>28</b> | <b>230</b> | <b>570</b> | <b>800</b> |

\* Choose any one Elective

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

**Theory : 06**  
**Practical : 02 (4hrs)**



## SIXTH SEMESTER

| Course Content | Paper Code                          | Name of the Course  | Ins. Hrs  | Credits   | Int. Marks | Ext Marks  | Total      |
|----------------|-------------------------------------|---|-----------|-----------|------------|------------|------------|
| Part-III       | 23U6BTC06                           | Core Paper VIII –<br>Bioentrepreneurship  | 5         | 5         | 25         | 75         | 100        |
|                | 23U6BTC07                           | Core Paper IX –<br>Pharmaceutical Biotechnology   | 5         | 5         | 25         | 75         | 100        |
|                | 23U6BTE05<br>23U6BTE06              | * Elective II -<br>Marine Biotechnology<br>/ Food Technology                                  | 4         | 4         | 25         | 75         | 100        |
|                | 23U6BTE07<br>23U6BTE08<br>23U6BTE09 | * Elective III -<br>Medical Biotechnology/<br>Forensic science /<br>Good Laboratory Practices | 4         | 4         | 25         | 75         | 100        |
| Part IV        | 23U6BTPR01                          | Project   | 10        | 5         | 40         | 60         | 100        |
| Part V         | 23U6BTSS06                          | Skill based Activities –<br>Online Course-NPTEL/MOOC  | -         | 1         |            |            |            |
| Part VI        | 23U6BTEX01                          | Extension Activities  | 2         | 1         |            |            |            |
| <b>Total</b>   |                                     |   | <b>30</b> | <b>25</b> | <b>140</b> | <b>360</b> | <b>500</b> |

\*Choose Any one for Elective II & III.

**Theory : 04**

**Project : 01**

### SCHEME OF EVALUATION

#### Evaluation Pattern for Internal Assessment (25 Marks)

- Internal Assessment - Best 2 Exam marks taken out of 3 (10 Marks)
- Assignment / Power point presentation / Case study (10 Marks)
- Attendance (5 Marks)

#### Evaluation Pattern for External Assessment (75 Marks)

- Section - A (Multiple Choice Questions) (1 x 10 = 10 Marks)
- Section - B (Five Mark Questions with choice) (7 x 5 = 35 Marks)
- Section - C (Ten Mark Questions with choice) (3 x 10 = 30 Marks)

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### MANDATORY SUBJECTS

- 1) Cell and Molecular Developmental Biology
- 2) Biological Chemistry
- 3) Genetics
- 4) Fundamentals of Microbiology

- 5) Immunology and Immunotechnology
- 6) Bioinstrumentation
- 7) Genetic Engineering and rDNA Technology
- 8) Bioinformatics and Biostatistics
- 9) Plant Biotechnology
- 10) Animal Biotechnology
- 11) Environmental and Industrial Biotechnology
- 12) Nano Biotechnology
- 13) Enzymology
- 14) Bioethics and Biosafety
- 15) Cancer Biology
- 16) Bio entrepreneurship
- 17) Pharmaceutical Biotechnology
- 18) Marine Biotechnology
- 19) Food Technology
- 20) Forensic science
- 21) Good Laboratory Practices

**FIRST YEAR - SEMESTER – I**  
**CORE- I: CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY**

| SubjectCode   | L  | T | P | S | Credits | Instructional<br>Hours | Marks |          |                |
|---|--|---|---|---|---------|------------------------|-------|----------|----------------|
|   |  |   |   |   |         |                        | CIA   | External | Total          |
| 23U1BTC01   | 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<br>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).<br>Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies -Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton. |   |   |   |         |                        |       |          | 20             |
| III   | Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.                  |   |   |   |         |                        |       |          | 15             |
| IV  | Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction – Secondary messenger types - G - Protein Coupled Receptors Signal transduction pathways.   |   |   |   |         |                        |       |          | 15             |

|                        |  |           |
|------------------------|--|-----------|
| V                      | Gametogenesis - Spermatogenesis and Oogenesis in mammals. Molecular events 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, Qxford University Press.   |           |
| 4                      | Lodish Harwey, 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              |
| 23U1BTA01                 | 3   | 1 |   |   | 3       | 4                   | 25    | 75       | 100                |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                    |
| LO1                       | Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding.   |   |   |   |         |                     |       |          |                    |
| LO2                       | Demonstrates the formation of different types of solutions, concentrations of solution and preparation of buffer solutions  |   |   |   |         |                     |       |          |                    |
| LO3                       | Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.   |   |   |   |         |                     |       |          |                    |
| LO4                       | Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.   |   |   |   |         |                     |       |          |                    |
| LO5                       | Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.  |   |   |   |         |                     |       |          |                    |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No.of Hours</b> |
| I                         | Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization. Electrophilic substitution reaction in benzene, nitration and sulphonation. |   |   |   |         |                     |       |          | 15                 |
| II                        | Acids & Bases properties and differences, Concepts of acids and bases- Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation, 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. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates overview – 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. Structure of Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids, Salvage & De novo pathway.  | 15 |
| V            | Classification and structure of amino acids. Structural conformation of proteins. Ramachandran Plot. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins and Hormones. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.   | 15 |
| <b>Total</b> |  | 75 |

#### **Text Books**

|   |  |
|---|--|
| 1 | P.L. Soni , A Text-book of Inorganic Chemistry, 11 <sup>th</sup> Edition, S. Chand & Sons publications             |
| 2 | Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1 <sup>st</sup> Edition |
| 3 | J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.                                  |
| 4 | A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.                              |
| 5 | Satyanarayana .U, 2016, Biochemistry, MJ publishers 3 <sup>rd</sup> edition (2006).                                |

#### **Reference Books**

|   |  |
|---|--|
| 1 | Lehninger (2013) Principles of Biochemistry 4 <sup>th</sup> edition WH Freeman and Company NY                          |
| 2 | Murray <i>et al.</i> , (2003) Harper's biochemistry 26 <sup>th</sup> edition Appleton and Lange Publishers Florida USA |

|                      |  |
|----------------------|--|
| 3                    | Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition. |
| 4                    | Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco                         |
| 5                    | Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 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">https://www.britannica.com</a> › science › biochemistry                                       |
| 4                    | <a href="https://www.sciencedirect.com">https://www.sciencedirect.com</a> › topics › agricultural-and-biological-sciences          |
| 5                    | <a href="https://biochemistry.org">https://biochemistry.org</a> › education › careers › becoming-a-bioscientist › w                |

#### 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               |
| 23U1BTCP01                |  |   | 4 |   | 2       | 4                   | 25    | 75           | 100                 |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |              |                     |
| LO1                       | Demonstrate the operation of Light Microscope  |   |   |   |         |                     |       |              |                     |
| LO2                       | Identify blood cells and its components  |   |   |   |         |                     |       |              |                     |
| LO3                       | Isolate and identify plant, and animal cells.  |   |   |   |         |                     |       |              |                     |
| LO4                       | Summarizes the concept of gametes  |   |   |   |         |                     |       |              |                     |
| LO5                       | Develop skill to perform cell fractionations.  |   |   |   |         |                     |       |              |                     |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                     |       |              | <b>No. of Hours</b> |
| I                         | Components of a Compound / Light Microscope.   |   |   |   |         |                     |       |              | 7                   |
| II                        | Blood smear preparation and Identification of Blood cells<br>Buccal smear preparation and Identification of squamous epithelial cells. |   |   |   |         |                     |       |              | 7                   |
| III                       | Isolation and Identification of plant cells.   |   |   |   |         |                     |       |              | 7                   |
| IV                        | Observation of sperm & Egg<br>Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.<br>Types of placenta in mammals.              |   |   |   |         |                     |       |              | 7                   |
| V                         | Cell fractionation and Identification of cell organelles (Demo)  |   |   |   |         |                     |       |              | 7                   |
| VI                        | Concept of staining, Types of staining and chemistry of staining .   |   |   |   |         |                     |       |              | 5                   |
| VII                       | Observation of cells on pond water.  |   |   |   |         |                     |       |              | 5                   |
|                           |  |   |   |   |         |                     |       | <b>Total</b> | <b>45</b>           |
| <b>Text Books</b>         |  |   |   |   |         |                     |       |              |                     |
| 1                         | K.V. Chaitanya, (2013), <i>Cell and molecular biology</i> : Lab manual, PHI publishers,. ISBN 978-81-203-800-4                         |   |   |   |         |                     |       |              |                     |

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

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

**Allied Practical I-  
BIOLOGICAL CHEMISTRY**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
| 23U1BTCP01                | 4   | 1 |   |   | 5       | 5                   | 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 sorensons formal titration method.   |   |   |   |         |                     |       |           |              |
| LO5                       | Estimate Glucose,Cholesterol and Proteins.  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents  |   |   |   |         |                     |       |           | No. of Hours |
| I                         | <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)<br>Detection of elements (N, Halogens)<br>Distinguish between aliphatic and aromatic compounds. Distinguish between Saturated and unsaturated compounds |   |   |   |         |                     |       |           | 9            |
| II                        | <b>Qualitative Analysis</b><br>Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose,sucrose, starch & glycogen.<br>Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.   |   |   |   |         |                     |       |           | 9            |
| 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   |   |   |   |         |                     |       |           | 9            |
| IV                        | <b>Colorimetric Analysis</b><br>1. Estimation of glucose – Anthrone method<br>2. Estimation of Cholesterol- Zak's method<br>3. Estimation of proteins – Bradford’s method and Lowry’s method.   |   |   |   |         |                     |       |           | 9            |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>45</b> |              |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |           |              |
| 1                         | J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.  |   |   |   |         |                     |       |           |              |
| 2                         | S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 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

|                | 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         | 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> |

**NON MAJOR ELECTIVE**

**Semester -I**

**FOOD AND NUTRITION**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks     |              |                     |
|---------------------------|---|---|---|---|---------|---------------------|-----------|--------------|---------------------|
|                           |   |   |   |   |         |                     | CIA       | External     | Total               |
| <b>23U1BTN01</b>          |   |   |   |   |         |                     | <b>25</b> | <b>75</b>    | <b>100</b>          |
| <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-Wilcoxpublishing.   |
| 5                      | Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalorepress.  |
| <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>    | <b>3</b>   | <b>2</b>   | <b>1</b>   | <b>1</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</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>CLO3</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>CLO4</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>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>TOT AL</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>    |

## HERBAL MEDICINE

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total               |
| 23U1BTN02                 | 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>Cynodondactylon</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>Adathoda vasica</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 ( <i>Moringa</i> , <i>Solanum nigrum</i> Cabbage).                  |   |   |   |         |                     |       |          | 15                  |
| Total                     |   |   |   |   |         |                     |       | 75       |                     |
| <b>Text Books</b>         |   |   |   |   |         |                     |       |          |                     |
| 1                         | R.K.Sinha & Shweta Sinha (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> |   |
| <b>1</b>               | <b>Steven Horne and Thomas Easley (2016), Modern Herbal Dispensatory: A MedicineMaking Guide</b>  |
| <b>2</b>               | <b>M.C. Joshi (2007) Handbook of Indian Medicinal Plants Hardcover.</b>   |
| <b>3</b>               | Neelesh Malviya and Sapna Malviya (2019). <i>Herbal Drug Technology</i> , (1st Edition), CBS Publishers and Distributors, ISBN: 9789387964334.  |
| <b>4</b>               | 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. |
| <b>5</b>               | 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**

|                | <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>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>    |

## PUBLIC HEALTH AND HYGIENE

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total        |
| 23U1BTN03                 | 4   | 1 |   |   | 5       | 5                   | 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.  |   |   |   |         |                     |       |          | 15           |
| II                        | Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkor, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).  |   |   |   |         |                     |       |          | 15           |
| III                       | Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chikungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.   |   |   |   |         |                     |       |          | 15           |
| 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. |   |   |   |         |                     |       |          | 15           |

|                        |  |           |
|------------------------|--|-----------|
| V                      | Health Services Organizations: World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and Indian Red Cross (IRC).                    |           |
| <b>Total</b>           |  | <b>75</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>    |

## ENVIRONMENT MANAGEMENT IN INDUSTRIES

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total        |
| 23U1BTN04                 | 4   | 1 |   |   | 5       | 5                   | 25    | 75       | 100          |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |              |
| LO1                       | The student understands the need of Instruments for Medical field   |   |   |   |         |                     |       |          |              |
| LO2                       | Can examine the setup of Dairy Industry   |   |   |   |         |                     |       |          |              |
| LO3                       | learn the Management skills for Agri Industry   |   |   |   |         |                     |       |          |              |
| LO4                       | understanding of hazards in Workplace   |   |   |   |         |                     |       |          |              |
| LO5                       | Gains knowledge about Industrial hazards and its prevention   |   |   |   |         |                     |       |          |              |
| UNIT                      | Contents  |   |   |   |         |                     |       |          | No. of Hours |
| I                         | Introduction to life science, computer in life science-Medical imaging, Genomics and phylogenetics, Drug design and discovering, Assistive robotics, Brain-computer interfaces, Simulation of biological systems and Medical treatment optimization.  |   |   |   |         |                     |       |          | 15           |
| II                        | Introduction to Dairy industries, The Structure of Dairying in Developing Countries, Application of Computer in Dairy Industry, Milk Procurement & Billing, Plant Automation, Computerized Accounting System, Applications of Management Information System (MIS), Packaging, Supply Chain Integration and Traceability.  |   |   |   |         |                     |       |          | 15           |
| III                       | Agribusiness - Application of marketing and decision making in contemporary agribusiness firms. Marketing strategies, marketing research and information, segmentation and targeting, Professional selling skills and knowledge – Rural Development – NABARD.   |   |   |   |         |                     |       |          | 15           |
| IV                        | Hazards in the workplace: Pressure, Biological, Chemical, Electricity, Fire, Heat & Cold, Indoor Air Quality, Lighting, Noise, ergonomics, Radiation (ionizing & non ionizing), Vibrations, hours of work, violence in work place, Understanding of Material Safety Data Sheets, Accidents and Safety Management: Accident Prevention methods, Safety Management and audit, Personal Protection Approaches. |   |   |   |         |                     |       |          | 15           |

|                        |   |           |
|------------------------|---|-----------|
| V                      | Occupational Health & Industrial Hygiene: Scientific and engineering basis for occupational health, biological monitoring (e.g. BEI), Occupational Hygiene, Concept of First Aid, Preventive Measures, and Occupational Health & Safety Management System: OHSAS – 18000.   | 15        |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Multi-Criteria Decision Analysis for Risk Assessment and Management, Editors Jingzheng Ren, Series Title <u>Industrial Ecology and Environmental Management</u> PublisherSpringer Cham, DOI <a href="https://doi.org/10.1007/978-3-030-78152-1">https://doi.org/10.1007/978-3-030-78152-1</a>   |           |
| 2                      | Environmental Management,<br>Butterworth-Heinemann,Editor(s): Iyyanki V. Muralikrishna, Valli Manickam,<br>2017,<br>Page iv,<br>ISBN 9780128119891,<br><a href="https://doi.org/10.1016/B978-0-12-811989-1.12001-9">https://doi.org/10.1016/B978-0-12-811989-1.12001-9</a> .<br>( <a href="https://www.sciencedirect.com/science/article/pii/B9780128119891120019">https://www.sciencedirect.com/science/article/pii/B9780128119891120019</a> ) |           |
| 3                      | Life Cycle Sustainability Assessment for Decision-Making<br>Methodologies and Case Studies<br>Book • 2020 Editors<br>Jingzheng Ren & Sara Toniolo   |           |
| <b>Reference Books</b> |   |           |
| 1                      | Lalat Chander, 2010. Text book of Dairy Plant Layout and Design, ICAR, New Delhi.   |           |
| 2                      | Larry R. Collins, 2001.Physical Hazards of the Workplace, CRC Press, Taylor&Francis group.  |           |
| 3                      | Andrew Barkley, 2013, Principles of Agricultural Economics, Taylor&Francis group.   |           |
| 4                      | Mishra R.K., 2015. Occupational health management, Aitbs Publishers and Distributors- Delhi.  |           |

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

|                | <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>3</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>    | <b>3</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>CLO3</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</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>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</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>3</b>    | <b>3</b>    |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>13</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2.6</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |

## BASICS IN LAB SAFETY

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |              |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|--------------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External     | Total        |
| 23U1BTSS01                |  | 3 |   |   | 3       | 3                   | 25    | 75           | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |              |              |
| LO1                       | Respond to laboratory emergency procedures of laboratory incidents or accidents.   |   |   |   |         |                     |       |              |              |
| LO2                       | Know the laboratory safety signs.  |   |   |   |         |                     |       |              |              |
| LO3                       | Differentiate the various biological safety levels.  |   |   |   |         |                     |       |              |              |
| LO4                       | Adopt for PPE usage and protective measures.   |   |   |   |         |                     |       |              |              |
| LO5                       | Understand the disposal of experimental wastes and spillclean-up.  |   |   |   |         |                     |       |              |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |              | No. of Hours |
| I                         | General Lab Safety: Lab rules and safety signs, Personal protective equipment, protecting clothing, hand protections, foot protection, hearing protection, respiratory protection, Eye and face Protection.  |   |   |   |         |                     |       |              | 7            |
| II                        | Glassware Safety: Inspecting glassware before use, safe handling and storage, vacuum and pressure operations, cleaning and drying, disposal and spillclean-up.   |   |   |   |         |                     |       |              | 7            |
| III                       | Chemical and Electrical Safety: Safety Data sheet, storage guide lines, chemical spills, chemical exposure monitoring; Electricity general specifications, electrical system usage guidelines, preventing electrical Hazards.  |   |   |   |         |                     |       |              | 8            |
| IV                        | Biological safety: Biological safety levels, safety data sheets for infectious substances, de contamination, transport and shipment of biological materials, emergencies, exposures and spills, biological waste disposal.   |   |   |   |         |                     |       |              | 8            |
| V                         | Emergency procedures and response to accidents: Emergency procedures-Spill, First aid and Emergency kits, protective procedures, Fire extinguishers, eye wash stations, Emergency showers, Responses–chemical spills, gas leakages, fire and explosions, personal injury and contaminations. |   |   |   |         |                     |       |              | 10           |
| VI                        | <b>Contemporary Classes:</b> Videos one emergency procedure, response to incidents, biological and chemical waste disposals  |   |   |   |         |                     |       |              | 5            |
|                           |  |   |   |   |         |                     |       | <b>Total</b> | <b>40</b>    |
|                           |  |   |   |   |         |                     |       |              |              |



## Reference Books

|   |   |
|---|---|
| 1 | Laboratory Safety Handbook, 1st Edition, Sabanc University (2016).  |
| 2 | Raj Mohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.  |
| 3 | Bioethics & Biosafety By Sateesh Mk (2008), Ik Publishers.  |
| 4 | <a href="https://www.ccri.edu/safety/lab_safety_for_students.html">https://www.ccri.edu/safety/lab_safety_for_students.html</a> .   |
| 5 | <a href="https://www.esafety.com/courses/spill-response-awareness/">https://www.esafety.com/courses/spill-response-awareness/</a> .   |
| 6 | <a href="https://ehs.ucsc.edu/programs/research-safety/video-resources.html#fire-safety">https://ehs.ucsc.edu/programs/research-safety/video-resources.html#fire-safety</a> . |

## SEMESTER – II

### CORE II GENETICS

| Subject Code       | L   | T | P | S | Credits | Instructional Hours | Marks |          |              |
|--------------------|---|---|---|---|---------|---------------------|-------|----------|--------------|
|                    |   |   |   |   |         |                     | CIA   | External | Total        |
| 23U2BTC02          | 4   | 1 |   |   | 5       | 5                   | 25    | 75       | 100          |
| Learning Objective |   |   |   |   |         |                     |       |          |              |
| LO1                | Learn about the classical genetics and transmission of characters from one generation to the next.  |   |   |   |         |                     |       |          |              |
| LO2                | Obtain a strong foundation for the advanced genetics.   |   |   |   |         |                     |       |          |              |
| LO3                | Explain the properties of genetic materials and storage and processing of genetic information.  |   |   |   |         |                     |       |          |              |
| LO4                | Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.  |   |   |   |         |                     |       |          |              |
| LO5                | Categories Eugenics, Euphenics and Euthenics and in depth Knowledge on population Genetics.   |   |   |   |         |                     |       |          |              |
| UNIT               | Contents  |   |   |   |         |                     |       |          | No. of Hours |
| I                  | Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.  |   |   |   |         |                     |       |          | 15           |
| II                 | Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex- Determination in Man. |   |   |   |         |                     |       |          | 15           |
| III                | Fine structure of the gene and gene concept, overview of Operon Concept, Lac operon and Try operon. 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)   |   |   |   |         |                     |       |          | 15           |

|                        |  |    |
|------------------------|--|----|
| V                      | Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Overview of Eugenics, Euphenics and Euthenics. | 15 |
| <b>Total</b>           |  | 75 |
| <b>Text Books</b>      |  |    |
| 1                      | Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram  |    |
| 2                      | Nath Publications, Meerut, 250001. www.knrnpublishings.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                      | www.dnaftb.org_<br>www.microbiologynotes.org_<br>www.scilearn.org_<br>www.scihub.org_<br>www.scitificamerican.org  |    |
| 3                      | <a href="http://enjoy.m.wikipedia.org">http://enjoy.m.wikipedia.org</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**

| SubjectCode               | L  | T | P | S | Credits | Instructional Hours | Marks |              |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|--------------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External     | Total        |
| 23U2BTA02                 | 3  | 1 |   |   | 3       | 4                   | 25    | 75           | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |              |              |
| LO1                       | Understand the classification of Microorganisms and structure of bacteria  |   |   |   |         |                     |       |              |              |
| LO2                       | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.  |   |   |   |         |                     |       |              |              |
| LO3                       | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes.  |   |   |   |         |                     |       |              |              |
| LO4                       | Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizers prebiotics and probiotics.  |   |   |   |         |                     |       |              |              |
| LO5                       | Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications.  |   |   |   |         |                     |       |              |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |              | No. of Hours |
| I                         | History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology.   |   |   |   |         |                     |       |              | 15           |
| II                        | Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram's, capsule, 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.  |   |   |   |         |                     |       |              | 15           |
| IV                        | Bioinsecticides - <i>Bacillus thuringiensis</i> , Baculoviruses- Biofertilizers - <i>Azospirillum</i> and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).  |   |   |   |         |                     |       |              | 15           |
| V                         | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). |   |   |   |         |                     |       |              | 15           |
|                           |  |   |   |   |         |                     |       | <b>Total</b> | <b>75</b>    |

| <b>Text Books</b>      |  |
|------------------------|--|
| 1                      | Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.   |
| 2                      | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.   |
| 3                      | Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013.  |
| 4                      | Prescott, Harley, Klein, Microbiology, 10 <sup>th</sup> Edition, McGraw – Hill, 2016.  |
| 5                      | Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC   |
| <b>Reference Books</b> |  |
| 1                      | Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14 <sup>th</sup> edition, 2017.  |
| 2                      | Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4 <sup>th</sup> edition, 2012.   |
| 3                      | Boyd, R.F. (1998). General Microbiology,2 <sup>nd</sup> Edition., Times Mirror, Mosby CollegePublishing, St Louis.   |
| 4                      | Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11 <sup>th</sup> Edition., A La Carte Pearson.   |
| 5                      | Salle. A.J (1992). Fundamental Principles of Bacteriology. 7 <sup>th</sup> Edition., McGraw Hill Inc.New York.   |
| <b>Web Resources</b>   |  |
| 1                      | <u><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>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 3          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 3          | 3          | 2          | 3          | 2          | 3           | 3           | 2           |
| <b>CLO5</b>    | 3          | 3          | 2          | 3          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>14</b>  | <b>14</b>  | <b>14</b>  | <b>14</b>  | <b>15</b>   | <b>14</b>   | <b>14</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>2.8</b> | <b>2.8</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

## Core Practical II –

### Genetics

| SubjectCode               | L  | T | P | S | Credits | Instructional<br>Hours | Marks |           |                 |
|---------------------------|--|---|---|---|---------|------------------------|-------|-----------|-----------------|
|                           |  |   |   |   |         |                        | CIA   | External  | Total           |
| 23U2BTCP02                |  |   | 4 |   | 2       | 4                      | 25    | 75        | 100             |
| <b>Learning Objective</b> |  |   |   |   |         |                        |       |           |                 |
| LO1                       | Demonstrate the basic principles of important techniques in Molecular biology and Genetics.  |   |   |   |         |                        |       |           |                 |
| LO2                       | Analyze the Polytene chromosome of the organisms   |   |   |   |         |                        |       |           |                 |
| LO3                       | Identify Barr bodies from Buccal smear   |   |   |   |         |                        |       |           |                 |
| LO4                       | Demonstrate the Preparations and maintenance of culture medium   |   |   |   |         |                        |       |           |                 |
| LO5                       | Demonstrate Human karyotyping  |   |   |   |         |                        |       |           |                 |
| UNIT                      | Contents   |   |   |   |         |                        |       |           | No. of<br>Hours |
| 1                         | Mitotic stages of onion ( <i>Allium cepa</i> ) root tip Meiotic stages of cockroach testes/ Flower bud   |   |   |   |         |                        |       |           | 9               |
| II                        | Giant chromosomes from Chironomus larvae/ Drosophila salivary glands   |   |   |   |         |                        |       |           | 9               |
| III                       | Identification of Barr bodies from Buccal smear  |   |   |   |         |                        |       |           | 9               |
| IV                        | Preparations of culture medium and culture of Drosophila – methods of maintenance<br>Identifications of mutants of Drosophila  |   |   |   |         |                        |       |           | 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<br>Panigrahi |   |   |   |         |                        |       |           |                 |



**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 PRACTICAL II  
FUNDAMENTALS OF MICROBIOLOGY**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks     |                     |       |  |
|---------------------------|---|---|---|---|---------|---------------------|-----------|---------------------|-------|--|
|                           |   |   |   |   |         |                     | CIA       | External            | Total |  |
| 23U2BTAP02                |   |   | 4 |   | 2       | 4                   | 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.   |   |   |   |         |                     |           |                     |       |  |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |           | <b>No. of Hours</b> |       |  |
| I                         | Sterilization techniques – Preparation of Media   |   |   |   |         |                     |           | 9                   |       |  |
| II                        | Inoculation techniques- Pour plate, Streaking techniques, spread plate<br>Isolation of bacteria from various sources and dilution techniques. |   |   |   |         |                     |           | 9                   |       |  |
| III                       | Staining techniques: Simple, Gram's, Capsule (Negative), Spores,<br>Preparation of temporary mounts- Lacto phenol cotton blue staining.       |   |   |   |         |                     |           | 9                   |       |  |
| IV                        | Motility tests: Hanging drop technique.   |   |   |   |         |                     |           | 9                   |       |  |
| V                         | Biochemical characterization - catalase, oxidase, IMVIC test and TSI. Antibiotic sensitivity test (demonstration).                            |   |   |   |         |                     |           | 9                   |       |  |
| <b>Total</b>              |   |   |   |   |         |                     | <b>45</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>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          | 2          | 2          | 1          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 2          | 2          | 2          | 1          | 1          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 2          | 1          | 1          | -          | 1          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 1          | 2          | 3          | 2          | 3           | 3           | 2           |
| <b>CLO5</b>    | 3          | 3          | 2          | 3          | 3          | 2          | 3           | 2           | 3           |
| <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>AVERAGE</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>  |

**NON MAJOR ELECTIVE**  
**SEMESTER – II**  
**GOOD LABORATORY PRACTICES (GLP)**

| SubjectCode               | L   | T | P | S | Credits | Instructional<br>Hours | Marks |          |                         |
|---------------------------|---|---|---|---|---------|------------------------|-------|----------|-------------------------|
|                           |   |   |   |   |         |                        | CIA   | External | Total                   |
| 23U2BTN05                 | 4   | 1 |   |   | 5       | 5                      | 25    | 75       | 100                     |
| <b>Learning Objective</b> |   |   |   |   |         |                        |       |          |                         |
| <b>LO1</b>                | The student obtains adequate information to setup Biotechnology Laboratory  |   |   |   |         |                        |       |          |                         |
| <b>LO2</b>                | learn to prepare solutions and maintenance of lab   |   |   |   |         |                        |       |          |                         |
| <b>LO3</b>                | can demonstrate the working of lab equipment's  |   |   |   |         |                        |       |          |                         |
| <b>LO4</b>                | learns about Biotechnology lab standards  |   |   |   |         |                        |       |          |                         |
| <b>LO5</b>                | gains knowledge about Safety measures   |   |   |   |         |                        |       |          |                         |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                        |       |          | <b>No. of<br/>Hours</b> |
| 1                         | Biotechnology lab organization - Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique. |   |   |   |         |                        |       |          | 15                      |
| II                        | Lab ethics - Regulatory affairs: Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).   |   |   |   |         |                        |       |          | 15                      |
| III                       | Instrument calibration and importance - Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtome, Electronic balances, Bio safety cabinets. SOP preparation for instrumentation.  |   |   |   |         |                        |       |          | 15                      |
| IV                        | GLP & Biotechnology Industry standards - Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.   |   |   |   |         |                        |       |          | 15                      |

|                        |   |           |
|------------------------|---|-----------|
| V                      | Types of wastes and safe disposal methods - Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel. | 15        |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.   |           |
| 2                      | 2nd Edition<br>GLP Essentials<br>A Concise Guide to Good Laboratory Practice, Second Edition<br>By Milton A. Anderson<br>Copyright Year 2002  |           |
| 3                      | Principles of Good Laboratory Practice Paperback – 1 January 2020<br>by Pradeep Deshmukh (Author)   |           |
| <b>Reference Books</b> |   |           |
| 1                      | Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference Paperback – Import, 18 October 2010<br>by <u>Mindy J Allport-Settle</u> (Author)   |           |
| 2                      | Good Laboratory Practice Standards: Applications for Field and Laboratory Studies (ACS Professional Reference Book) 1st Edition<br>by <u>Willa Y. Garner</u> (Editor), <u>Maureen S. Barge</u> (Editor), <u>James P. Ussary</u> (Editor)  |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="https://www.oecd.org/chemicalsafety/testing/overview-of-good-laboratory-practice.htm">https://www.oecd.org/chemicalsafety/testing/overview-of-good-laboratory-practice.htm</a>   |           |
| 2                      | <a href="https://www.intechopen.com/chapters/22127">https://www.intechopen.com/chapters/22127</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>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>1</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>   | <b>1</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>   | <b>1</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO4</b>    | <b>3</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>CLO5</b>    | <b>3</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>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>13</b>  | <b>9</b>   | <b>13</b>  | <b>10</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>3</b>   | <b>2.6</b> | <b>1.8</b> | <b>2.6</b> | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |

## ORGANIC FARMING AND HEALTH MANAGEMENT

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
| 23U2BTN06                 | 4   | 1 |   |   | 5       | 5                   | 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.   |   |   |   |         |                     |       |           | 15           |
| II                        | Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.   |   |   |   |         |                     |       |           | 15           |
| III                       | Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability. |   |   |   |         |                     |       |           | 15           |
| IV                        | Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.                                 |   |   |   |         |                     |       |           | 15           |
| V                         | Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.   |   |   |   |         |                     |       |           | 15           |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>75</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. |
| 2                      | Mangala rai, 2012.Hand Book of Agriculture, Sixth Edition, ICAR New Delhi.   |
| 3                      | B.B. Sharma , 2007. A Guide to Home Gardening, Second Edition, MIB India, New Delhi.   |
| 4                      | Adrienne E. Hardman, 2009. Physical Activity and Health – The evidence explained, Second edition, Taylor and Francis Group.                  |
| <b>Reference Books</b> |  |
| 1                      | Farmers of Forty Centuries: Permanent Organic Farming in China, Korea, and Japan Hardcover – 10 June 2011<br>by <u>F. H. King</u> (Author)   |
| 2                      | Organic Farming: Components And Management Edition: 1 Author/s:Gehlot D ,<br>Publisher: M/s AGROBIOS (INDIA) ISBN: 9788177544008             |



## BIOTECHNOLOGY FOR SOCIETY

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External  | Total        |
| 23U2BTN07                 | 4  | 1 |   |   | 5       | 5                   | 25    | 75        | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |           |              |
| LO1                       | Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation  |   |   |   |         |                     |       |           |              |
| LO2                       | Will gain knowledge about the production of Bio fertilizer and advantages of Biopesticides   |   |   |   |         |                     |       |           |              |
| LO3                       | Will understand the significance of microorganisms in Biodegradation   |   |   |   |         |                     |       |           |              |
| LO4                       | Will get know about History of Antibiotics   |   |   |   |         |                     |       |           |              |
| LO5                       | Will able to comprehend about Transgenic Plants  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |           | No. of Hours |
| I                         | Introduction to Biotechnology- Role of Biotechnology in sericulture-Rearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained- Mushroom farming stages- Cultivation of paddy straw mushroom-Importance of mushroom cultivation. |   |   |   |         |                     |       |           | 15           |
| II                        | Biofertilizer- Definition- Mass production of <i>Rhizobium</i> -Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- <i>Bacillus huringiensis</i> - Single cell protein- Introduction- history- production of <i>Spirulina</i> SCP- Applications- Advantages & disadvantages.               |   |   |   |         |                     |       |           | 15           |
| III                       | Biodegradation- Definition- Process-role of microorganisms in biodegradation biodegradable plastics-advantages- Bio weapons- introduction- history- potential agents- delivery methods- harmful effects.   |   |   |   |         |                     |       |           | 15           |
| IV                        | Antibiotics- Definition- Introduction and history of antibiotics- sources- classification- spectrum- production of penicillin- definition of antibiotic resistance.  |   |   |   |         |                     |       |           | 15           |
| V                         | Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.   |   |   |   |         |                     |       |           | 15           |
| <b>Total</b>              |  |   |   |   |         |                     |       | <b>75</b> |              |

| <b>Text Books</b>      |  |
|------------------------|--|
| <b>1</b>               | Sathyanarayana, U., Chakrapani, U., (2008). <i>Biotechnology</i> , First edition, Books and allied (P) Ltd, Kolkata.   |
| <b>2</b>               | A.K. Chatterji, (2011). <i>Introduction to Environmental Biotechnology</i> , Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9              |
| <b>3</b>               | R.C. Dubey, (2014). <i>A text book of Biotechnology</i> , S.Chand & Company, New Delhi. ISBN 9788121926089   |
| <b>4</b>               | H. Patel, (2011). <i>Industrial Microbiology</i> , (2 <sup>nd</sup> edition), MacMillan Publishers   |
| <b>5</b>               | Thakur, I.S., (2019). <i>Environmental Biotechnology- Basic principles and applications</i> - (2 <sup>nd</sup> edition)- Dreamtech Press, ISBN 978-93-89307-55-9 |
| <b>Reference Books</b> |  |
| <b>1</b>               | Basics of Biotechnology Paperback – 1 January 2004<br>by A.J. Nair (Author) Publisher<br>Laxmi Publications  |
| <b>2</b>               | Basic Biotechnology Paperback – 2 February 2008<br>by Ratledge Colin (Author) Publisher<br>Cambridge University Press  |

**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>3</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>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>    | <b>3</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    |
| <b>CLO4</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO5</b>    | <b>3</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>TOTAL</b>   | <b>15</b>  | <b>14</b>  | <b>15</b>  | <b>15</b>  | <b>14</b>  | <b>15</b>  | <b>13</b>   | <b>14</b>   | <b>15</b>   |
| <b>Average</b> | <b>3</b>   | <b>2.8</b> | <b>3</b>   | <b>3</b>   | <b>2.8</b> | <b>3</b>   | <b>2.6</b>  | <b>2.8</b>  | <b>5</b>    |

## COMPUTATIONAL BIOLOGY

| Subject Code              | L  | T | P | S | Credits | Instructional<br>Hours | Marks |          |                 |
|---------------------------|--|---|---|---|---------|------------------------|-------|----------|-----------------|
|                           |  |   |   |   |         |                        | CIA   | External | Total           |
| 23U2BTN08                 | 4  | 1 |   |   | 5       | 5                      | 25    | 75       | 100             |
| <b>Learning Objective</b> |  |   |   |   |         |                        |       |          |                 |
| LO1                       | Will understand Primary and Secondary Biological Databases which are currently used in Bioinformatics  |   |   |   |         |                        |       |          |                 |
| LO2                       | Will able to identify the similarity between the Sequences by using different software's   |   |   |   |         |                        |       |          |                 |
| LO3                       | Develop skills to generate Phylogenetic trees for the analysis of multiple sequences alignment and phylogenetic analysis (PHYLIP)  |   |   |   |         |                        |       |          |                 |
| LO4                       | Will gain knowledge of Drug Discovery and Drug designing   |   |   |   |         |                        |       |          |                 |
| LO5                       | Will expertise in Structure prediction of proteins and homology modeling of proteins by learning different types of Visualization tools and Gene prediction tools.   |   |   |   |         |                        |       |          |                 |
| UNIT                      | Contents   |   |   |   |         |                        |       |          | No. of<br>Hours |
| I                         | Overview and Definition, Application of Bioinformatics, Sequences format used in Bioinformatics- Biological Database: Introduction, Classification of biological databases, Primary database- Nucleic acids- NCBI-DDBJ-EMBL. Protein- PDB- SWISSPORT. Secondary database- PROSITE, PFAM. Structure and classification-SCOP-CATH, Metabolic pathway database. |   |   |   |         |                        |       |          | 15              |
| II                        | Sequences similarity, Identify & homology- Definition of homologues, Orthologues, Paralogues. Scoring matrices, Pairwise Sequences alignment. Dot Matrix, BLAST, FASTA- Needleman Wunsch – Smith and waterman Algorithm.   |   |   |   |         |                        |       |          | 15              |
| III                       | Multiple Sequences alignment – Different method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenic trees- rooted and unrooted tree- Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis (PHYLIP).   |   |   |   |         |                        |       |          | 15              |
| IV                        | History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.   |   |   |   |         |                        |       |          | 15              |

|                        |   |           |
|------------------------|---|-----------|
| V                      | Protein prediction - Study of internet resources in Bioinformatics -Tools for primary (Compute PT/Mw, Protparam), secondary (PROSITE), Tertiary (Swiss Model), Structure prediction of proteins, Homology modeling of proteins. Visualization tools (RASMOL), Gene prediction tools (Genscan, Grail). | 15        |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Rastogi, S.C, Mendiratta, N,Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.   |           |
| 2                      | David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.  |           |
| 3                      | D.R.Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.  |           |
| 4                      | Gautam B. Singh., Fundamentals of Bioinformatics and Computational Biology, Oakland University Rochester, Michigan USA.   |           |
| 5                      | Arthur M.Lesk., Introduction to bioinformatics., Oxford University Press.   |           |
| <b>Reference Books</b> |   |           |
| 1                      | Mohammad AmjadManaullahAbid. (2019). <i>Fundamentals of Computers</i> . (1 <sup>st</sup> Ed.)DreamtechPress, ISBN-978-93-89520-39-2   |           |
| 2                      | S.P. Gupta (2019), <i>Biostatistical methods</i> (1 <sup>st</sup> Ed.)Sultan Chand and Sons, ISBN 93-5161-112-7   |           |
| 3                      | Veer Bala Rastogi (2018). <i>Biostatistics</i> . Medtech Publisher, ISBN: 9789384007591, 9384007595   |           |
| 4                      | Jerrold H. Zar (2014), <i>Biostatistical Analysis</i> (5 <sup>th</sup> Ed), New Delhi: Pearson Education  |           |
| 5                      | Priti Sinha Pradeep K. Sinha (2018). <i>Computer Fundamentals</i> (6 <sup>th</sup> Ed.) BPB Publications; Reprint Edition, ISBN: 9788176567527  |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="http://www.expasy.org">www.expasy.org</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          | 2          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | 15         | 15         | 15         | 13         | 13         | 15         | 15          | 15          | 15          |
| <b>Average</b> | 3          | 3          | 3          | 2.6        | 2,6        | 3          | 3           | 3           | 3           |



## BASIC CALCULATIONS IN BIOLOGY

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |                    |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|--------------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total              |
| 23U2BTSS02                | 4   | 1 |   |   | 4       | 3                   | 25    | 75       | 100                |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                    |
| LO1                       | Acquiring knowledge on round off of numbers.  |   |   |   |         |                     |       |          |                    |
| LO2                       | Understanding the basic concepts of calculations in preparation of solutions  |   |   |   |         |                     |       |          |                    |
| LO3                       | To understand the rule of logarithms.   |   |   |   |         |                     |       |          |                    |
| LO4                       | To gain over all information to calculate with time.  |   |   |   |         |                     |       |          |                    |
| LO5                       | Acquiring knowledge on calculating expected genotype.   |   |   |   |         |                     |       |          |                    |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No.of Hours</b> |
| I                         | Scientific Notation: Scientific Notation and Metric Prefixes – Rounding Off Significant Digits in Calculations – Converting Numbers from Scientific Notation to Decimal Notation. Conversion Factors and Canceling Terms.   |   |   |   |         |                     |       |          | 13                 |
| II                        | Solutions Mixtures: Solutions Mixtures and Media – solution Concentrations by a Factor of X-Preparing Percent Solutions – Diluting Percent Solutions – Moles and Molecular Weight: Definitions – and Converting Molarity to Percent-Converting Percent to Molarity - definitions of Ph. |   |   |   |         |                     |       |          | 13                 |
| III                       | Rule For Logarithms – PCR – The Polymerase Chain Reaction-PCR Efficiency- Definition of Product Rule for Logarithms – Power Rule for Logarithms – Calculating the T mof the Target Sequence- dNTPs- Quantitative PCR.   |   |   |   |         |                     |       |          | 14                 |
| IV                        | Calculating with Times: Centrifugation-Relative Centrifugal Force (gForce) and Calculating Sedimentation Times – Converting Force to Revolution sper Minute – Definition Forensic Science -Alleles and Genotypes.   |   |   |   |         |                     |       |          | 15                 |
| V                         | Calculating Expected Genotype: Calculating Genotype Frequencies – Calculating Allele Frequencies- The Hardy – Weinberg Equation and Calculating Expected Genotype Frequencies –Sample Variance and Sample Standard Deviation – The Multiplication Rule.                                 |   |   |   |         |                     |       |          | 15                 |
| VI                        | Video Lectures, Seminars and Webinars   |   |   |   |         |                     |       |          | 5                  |
| <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  |

**SEMESTER – III**

**Core III - IMMUNOLOGY AND IMMUNOTECHNOLOGY**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |           |             |
|---------------------------|--|---|---|---|---------|---------------------|-------|-----------|-------------|
|                           |  |   |   |   |         |                     | CIA   | External  | Total       |
| 23U3BTC03                 | 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.  |   |   |   |         |                     |       |           |             |
| UNIT                      | Contents   |   |   |   |         |                     |       |           | No.of Hours |
| 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. Purification of antibodies.                                     |   |   |   |         |                     |       |           | 15          |
| IV                        | The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Biological function of C’ proteins. Cytokines- Structure and Function. Vaccines – Types, Production and application.                     |   |   |   |         |                     |       |           | 15          |
| 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. HLA tissue typing.   |   |   |   |         |                     |       |           | 15          |
| <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>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>3</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>3</b>   | <b>3</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>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>  |

**Allied Paper III –  
BIOINSTRUMENTATION**

| Subject Code              | L   | T        | P | S | Credits  | Instructional<br>Hours | Marks     |           |                        |
|---------------------------|---|----------|---|---|----------|------------------------|-----------|-----------|------------------------|
|                           |   |          |   |   |          |                        | CIA       | External  | Total                  |
| <b>23U3BTA03</b>          | <b>3</b>  | <b>1</b> |   |   | <b>3</b> | <b>4</b>               | <b>25</b> | <b>75</b> | <b>100</b>             |
| <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.  |          |   |   |          |                        |           |           |                        |
| <b>UNIT</b>               | <b>Contents</b>   |          |   |   |          |                        |           |           | <b>No.of<br/>Hours</b> |
| 1                         | 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 Upadhyay Nath. (2009). "Biophysical Chemistry", Principles and Techniques. Himalaya Publishing House.   |
| 2                      | L.Veerakumari, (2006) "Bioinstrumentation" MJP publishers , Kindle Edition.  |
| 3                      | Skoog D.A.F. James Holler and Stankovic, 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, New York.                                      |
| 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" Wiley India 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        |                     |            |
|---------------------------|--|----------|---|---|----------|---------------------|--------------|---------------------|------------|
|                           |  |          |   |   |          |                     | CIA          | External            | Total      |
| <b>23U3BTCPO3</b>         | <b>4</b>   | <b>1</b> |   |   | <b>5</b> | <b>5</b>            | <b>25</b>    | <b>75</b>           | <b>100</b> |
| <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<br>Rh typing.                                  |          |   |   |          |                     |              | 9                   |            |
| II                        | WBC counting<br>RBC counting<br>Differential blood count   |          |   |   |          |                     |              | 9                   |            |
| III                       | WIDAL Slide test   |          |   |   |          |                     |              | 9                   |            |
|                           | ASO test   |          |   |   |          |                     |              |                     |            |
| IV                        | Double<br>Immunodiffusion<br>Single Radial<br>Immunodiffusion  |          |   |   |          |                     |              | 9                   |            |
| V                         | ELISA – Demonstration<br>Handling of Laboratory animals -<br>Demonstration 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<br>Hours | Marks |          |                        |
|--------------------|---|---|---|---|---------|------------------------|-------|----------|------------------------|
|                    |   |   |   |   |         |                        | CIA   | External | Total                  |
| <b>23U3BTAP03</b>  | 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.  |   |   |   |         |                        |       |          |                        |
| <b>UNIT</b>        | <b>Contents</b>   |   |   |   |         |                        |       |          | <b>No.of<br/>Hours</b> |
| 1                  | Preparation of Buffer (Phosphate Buffer)<br><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, lipids by paper chromatography.  |   |   |   |         |                        |       |          | 9                      |
| IV                 | Chromatography analysis of sugar, amino acids, lipids 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**

|                | <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>15</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>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

| Subject Code | L | T | P | S | Credits | Instructional<br>Hours | Marks |          |       |
|--------------|---|---|---|---|---------|------------------------|-------|----------|-------|
|              |   |   |   |   |         |                        | CIA   | External | Total |
| 23U3BTSSP03  | 2 | 1 |   |   | 3       | 3                      | 40    | 60       | 100   |

## **COMPUTERS FOR BIOLOGY**

### **MS word**

Creating, editing, saving and printing text documents- Font and paragraph formatting-Simple character formatting-Inserting tables, smart art, page breaks- Using lists and styles- Working with images- Using Spelling and Grammar check- Understanding document properties- Mail Merge

### **Ms. Excel**

Spreadsheet basics- Creating, editing, saving and printing spreadsheets- Working with functions & formulas Modifying worksheets with color & autoformats Graphically representing data : Charts & Graphs Speeding data entry : Using Data Forms - Analyzing data : Data Menu, Subtotal, Filtering Data - Formatting worksheets - Securing & Protecting spreadsheets

### **Ms. Power Point**

Opening, viewing, creating, and printing slides - Applying auto layouts - Adding custom animation- Using slide transitions- Graphically representing data : Charts- & Graphs Creating Professional Slide for Presentation.-

### **Internet**

Understanding how to search/Google- bookmarking and Going to a specific website- Copy and paste Internet content into your word file and emails- Understanding social media platforms such as Facebook- & Many more learn with best practices

### **Biology Applications**

Chemical Drawing Tools - ACD Chems sketch – Marvin sketch; Visualization Tools- Chime – Rasmol; Poster making tools – Bio render, Canva; Video learning resource : Osmosis.

### **References**

Curtis Frye & Joan Lambert Microsoft Office Step by Step (Office 2021 and Microsoft 365) 1<sup>st</sup> Edition, 2022, Pearson Education (US)

Kumar Bittu, Mastering MS Office (2022) V&S Publishers

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

| Subject Code              | L  | T        | P | S | Credits  | Instructional Hours | Marks     |           |                     |
|---------------------------|--|----------|---|---|----------|---------------------|-----------|-----------|---------------------|
|                           |  |          |   |   |          |                     | CIA       | External  | Total               |
| <b>23U4BTC04</b>          | <b>5</b>   | <b>1</b> |   |   | <b>5</b> | <b>6</b>            | <b>25</b> | <b>75</b> | <b>100</b>          |
| <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.  |          |   |   |          |                     |           |           |                     |
| <b>UNIT</b>               | <b>Contents</b>  |          |   |   |          |                     |           |           | <b>No. of Hours</b> |
| 1                         | 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), Chromosome walking. 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, agriculture and r-DNA technology - merits and demerits. Gene editing – CRISPER/Cas9-TALEN DNA   |          |   |   |          |                     |           |           | 15                  |

|                        |   |           |
|------------------------|---|-----------|
| <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     |           |                     |
|---------------------------|--|----------|---|---|----------|---------------------|-----------|-----------|---------------------|
|                           |  |          |   |   |          |                     | CIA       | External  | Total               |
| <b>23U4BTA04</b>          | <b>3</b>   | <b>1</b> |   |   | <b>3</b> | <b>4</b>            | <b>25</b> | <b>75</b> | <b>100</b>          |
| <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, BLOSSUM.  |          |   |   |          |                     |           |           | 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 Phylogenic trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design. |          |   |   |          |                     |           |           | 15                  |
| IV                        | Statistics – collection, classification, tabulations of Statistical Data –   |          |   |   |          |                     |           |           | 15                  |

|                        |   |           |
|------------------------|---|-----------|
|                        | Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency – measures of dispersion.   |           |
| V                      | Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Softwares. | 15        |
| <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>3</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>3</b>   | <b>3</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>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**

| SubjectCode               | L  | T | P | S | Credits  | Instructional<br>Hours | Marks     |                     |            |
|---------------------------|--|---|---|---|----------|------------------------|-----------|---------------------|------------|
|                           |  |   |   |   |          |                        | CIA       | External            | Total      |
| <b>23U4BTCP04</b>         | <b>4</b>   |   |   |   | <b>5</b> | <b>5</b>               | <b>25</b> | <b>75</b>           | <b>100</b> |
| <b>Learning Objective</b> |  |   |   |   |          |                        |           |                     |            |
| LO1                       | Isolate the Plasmid DNA and Genomic DNA. and predict the molecular weight of DNA by agarose gel electrophoresis. |   |   |   |          |                        |           |                     |            |
| LO2                       | Demonstrate working principles of PCR, RFLP and other important Genetic Engineering techniques.                  |   |   |   |          |                        |           |                     |            |
| LO3                       | Prepare the competent cells and perform bacterial transformation.  |   |   |   |          |                        |           |                     |            |
| LO4                       | Determine the restriction digestion of DNA   |   |   |   |          |                        |           |                     |            |
| LO5                       | Determine the restriction fragment length polymorphism.  |   |   |   |          |                        |           |                     |            |
| <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                       | Preparation of competent cells for transformation<br>Bacterial transformation                                    |   |   |   |          |                        |           | 9                   |            |
| IV                        | Restriction Digestion of DNA   |   |   |   |          |                        |           | 9                   |            |
| V                         | Restriction Fragment Length Polymorphism(DEMO)<br>PCR(Demonstration)<br>Ligation of DNA with Plasmid DNA.        |   |   |   |          |                        |           | 9                   |            |
| <b>Total</b>              |  |   |   |   |          |                        | <b>45</b> |                     |            |
| <b>Text Books</b>         |  |   |   |   |          |                        |           |                     |            |
| 1                         | <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>   | <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 IV-  
BIOINFORMATICS AND BIostatISTICS**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |              |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|--------------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External     | Total        |
| 23U4BTAP04                |  |   | 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 – Mean deviation, quartile deviation and standard deviation using MS EXCEL, 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.   |
| 4                      | Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics. Pearson Education Asia.  |
| 5                      | Primrose, S.B. 1998. Principle of genome analysis. 2nd edition. Blackwell Science.   |
| <b>Reference Books</b> |  |
| 1                      | Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.                          |
| 2                      | Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.        |
| <b>Web Resources</b>   |  |
| 1                      | Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne |
| 2                      | 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>3</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>3</b>   | <b>3</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>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>14</b>  | <b>15</b>   | <b>14</b>   | <b>14</b>   |
| <b>AVERAGE</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>  |

| Subject Code | L | T | P | S | Credits | Instructional<br>Hours | Marks |          |       |
|--------------|---|---|---|---|---------|------------------------|-------|----------|-------|
|              |   |   |   |   |         |                        | CIA   | External | Total |
| 23U4BTSDC01  | 2 | 1 |   |   | 2       | 2                      | 25    | 5        | 100   |

## Genome Editing

Unit – 1:

Introduction to genomics and gene regulation - organization and structure of genomes - gene regulation and diseases

Unit - II

Gene manipulation techniques - Transgenesis and site-specific recombination: Cre-Lox, Phi31 integrase, etc. - Genome editing: ZFNs, TALENs, CRISPR/Cas9 - Multi-gene assemblies and high-throughput DNA assembly techniques

Unit - III

Sequencing and mapping genomes - Sanger sequencing - Next Generation Sequencing - Techniques utilizing NGS: Chip-seq, RNA-seq, single-cell transcriptomics - Application to disease phenotyping

Unit -IV

Molecular imaging - Fluorescent tagging of fixed and live cells - CRISPR-based DNA tagging, rainbow imaging - Quantitative and high-throughput single-cell image analysis

Unit - V

Application of genome engineering - Application in synthetic and developmental biology - Application in human genetics, disease phenotyping, etc.

## Reference Books

Molecular Biology of the Gene, 7th edition. J.D. Watson et al. Pearson

An Introduction to Genetic Engineering, 3rd edition. D.T. Nicholl. Cambridge University Press.

Gene Cloning and DNA Analysis: An Introduction, 7th edition. T.A. Brown. Wiley.

Principles of Gene Manipulation and Genomics, 7th edition. S.B. Primrose, R. Twyman. Wiley

**SEMESTER –V**

**PLANT BIOTECHNOLOGY**

| SubjectCode               | L   |   | P | S | Credits | Instructional Hours | Marks |          |                    |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|--------------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total              |
| 23U5BTC05                 | 4   | 1 |   |   | 5       | 5                   | 25    | 75       | 100                |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                    |
| LO1                       | Explore the history of Biotechnology and state the importance of organization of plantgenome  |   |   |   |         |                     |       |          |                    |
| LO2                       | Be acquainted with the molecular basis of action of plant hormones and gene expression  |   |   |   |         |                     |       |          |                    |
| LO3                       | Illustrate about various culture medium preparations, haploid, triploid plant production andits applications  |   |   |   |         |                     |       |          |                    |
| LO4                       | Exploit symbiotic organisms as a vector for gene transfer to produce transgenic plants  |   |   |   |         |                     |       |          |                    |
| LO5                       | Develop molecular technique skills for crop improvement.  |   |   |   |         |                     |       |          |                    |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No.of Hours</b> |
| <b>I</b>                  | History of plant biotechnology, Conservation of Plant using Biotechnology. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.   |   |   |   |         |                     |       |          | 15                 |
| <b>II</b>                 | Auxins, cytokinins and gibberlins – molecular basis of action – phytochrome – role in photomorphogeneisis – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.   |   |   |   |         |                     |       |          | 15                 |
| <b>III</b>                | Media composition (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation, fusion and culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production. |   |   |   |         |                     |       |          | 15                 |
| <b>IV</b>                 | Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants,Tiand Ri Plasmid vectors and their utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.  |   |   |   |         |                     |       |          | 15                 |
| <b>V</b>                  | Crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Transgenic plants- plant vaccines, genetically modified food - future perspectives & ecological impact of   |   |   |   |         |                     |       |          | 15                 |

|                        |   |           |
|------------------------|---|-----------|
|                        | transgenic plants. IPR-Farmers and Breeders rights.   |           |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Sudhir, M. 2000. Applied Biotechnology and plant Genetics. Dominant publishers and distributors.  |           |
| 2                      | Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.   |           |
| 3                      | Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.   |           |
| 4                      | Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.   |           |
| 5                      | Chawla, H.S., “Introduction to Plant Biotechnology”, 3rd Edition, Science Publishers, 2009.   |           |
| <b>Reference Books</b> |   |           |
| 1                      | Kojima, Lee, H. and Kun, Y. 2001. Photosynthetic microorganisms in Environmental Biotechnology. Springer – Verlag.  |           |
| 2                      | Stewart Jr., C.N., “Plant Biotechnology and Genetics: Principles, Techniques and Applications” Wiley-Interscience, 2008.  |           |
| 3                      | Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.  |           |
| 4                      | Trigiano, R.N. and Gray, D.J. 1996. Plant tissue culture concepts and laboratory exercise. CRC Press. Boca Raton, New York.   |           |
| 5                      | Street, H.E. 1977. Plant tissue culture. Blackwell Scientific Publications, Oxford, London.   |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</a>   |           |
| 2                      | <a href="https://science.umd.edu/classroom/bsci124/lec41.html">https://science.umd.edu/classroom/bsci124/lec41.html</a>   |           |
| 3                      | <a href="https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology">https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology</a> |           |
| 4                      | <a href="http://mydunotes.blogspot.com/p/plant-biotechnology.html">http://mydunotes.blogspot.com/p/plant-biotechnology.html</a>   |           |
| 5                      | <a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</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          | 2          | 3          | 1          | 1          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 1          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 3          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 2          | 1          | 3          | 2          | 3           | 3           | 2           |
| <b>CLO5</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 2           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>13</b>  | <b>14</b>  | <b>9</b>   | <b>10</b>  | <b>12</b>  | <b>15</b>   | <b>14</b>   | <b>14</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.6</b> | <b>2.8</b> | <b>1.8</b> | <b>2</b>   | <b>2.4</b> | <b>3</b>    | <b>2.8</b>  | <b>2.8</b>  |

**Core Paper VI –  
ANIMAL BIOTECHNOLOGY**

| SubjectCode               | L  | T | P | S | Credits | Instructional<br>Hours | Marks |           |                |
|---------------------------|--|---|---|---|---------|------------------------|-------|-----------|----------------|
|                           |  |   |   |   |         |                        | CIA   | External  | Total          |
| 23U5BTC06                 |  |   |   |   | 5       | 5                      | 25    | 75        | 100            |
| <b>Learning Objective</b> |  |   |   |   |         |                        |       |           |                |
| LO1                       | Understand the basic concepts of Animal cell culture and cell laboratory   |   |   |   |         |                        |       |           |                |
| LO2                       | Describe the media preparation, preservation, trypsinization, counting, maintenance and application of cell lines.   |   |   |   |         |                        |       |           |                |
| LO3                       | Discuss the strategies for gene transfer and gene expressions with their applications.   |   |   |   |         |                        |       |           |                |
| LO4                       | Be acquainted with genetic modification and stem cell technology in production of transgenic animals.  |   |   |   |         |                        |       |           |                |
| LO5                       | Learn the Assisted reproductive technology and its applications.   |   |   |   |         |                        |       |           |                |
| UNIT                      | Contents   |   |   |   |         |                        |       |           | No.of<br>Hours |
| I                         | Animal cell culture – History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell line. Essential equipments required for animal cell culture. |   |   |   |         |                        |       |           | 15             |
| II                        | Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.   |   |   |   |         |                        |       |           | 15             |
| III                       | Transfection of cells in culture- Animal viral vectors for transfection, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications.  |   |   |   |         |                        |       |           | 15             |
| IV                        | Protein production by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products -Transgenic Animals.  |   |   |   |         |                        |       |           | 15             |
| V                         | Collection and preservation of embryos, Semen banking, AI, IVF and ICSI. Case Study-any two relevant studies. Vaccines – Types – Production.   |   |   |   |         |                        |       |           | 15             |
| <b>Total</b>              |  |   |   |   |         |                        |       | <b>75</b> |                |

| <b>Text Books</b>      |   |
|------------------------|---|
| 1                      | Ramasamy.P. 2002.Trends in Biotechnology, University of Madras of Publications, Pearl Press   |
| 2                      | Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.   |
| 3                      | K. Srivastava <i>et al.</i> , 2009, Animal Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd.   |
| 4                      | B.C. Currell <i>et al.</i> , 1994, In vitro Cultivation of Animal Cells (Biotol), Butterworth-Heinemann Ltd.  |
| 5                      | Jenkins, N. (ed). 1999 Animal cell Biotechnology: Methods and protocols. Humana press, New Jersey.  |
| <b>Reference Books</b> |   |
| 1                      | R. Ian Freshney, Culture of Animal cells – A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications.   |
| 2                      | Glick, B.R. and Pasternark. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA.   |
| 3                      | Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington.  |
| 4                      | Traven. 2001. Biotechnology. Tata McGraw – Hill.  |
| 5                      | Walker,J.M. and Gingold, E.B. 1999.Molecular biology and Biotechnology, 3 <sup>rd</sup> edition. Panima Publishing Corporation.   |
| <b>Web Resources</b>   |   |
| 1                      | <a href="http://ecoursesonline.iasri.res.in/course/view.php?id=350">http://ecoursesonline.iasri.res.in/course/view.php?id=350</a>   |
| 2                      | <a href="https://microbenotes.com/animal-cell-culture/">https://microbenotes.com/animal-cell-culture/</a>   |
| 3                      | <a href="https://biocyclopedia.com/index/biotechnology/animal_biotechnology/manipulation_of_reproduction_and_transgenic_animals/biotech_in_vitro_fertilization_technology.php">https://biocyclopedia.com/index/biotechnology/animal_biotechnology/manipulation_of_reproduction_and_transgenic_animals/biotech_in_vitro_fertilization_technology.php</a> |
| 4                      | <a href="https://thebiologynotes.com/embryo-transfer/">https://thebiologynotes.com/embryo-transfer/</a>   |
| 5                      | <a href="https://people.ucalgary.ca/~browder/transgenic.html">https://people.ucalgary.ca/~browder/transgenic.html</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          | 3          | 3          | 3          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 1          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 1          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 2          | 2          | 3          | 2          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>13</b>  | <b>14</b>  | <b>10</b>  | <b>12</b>  | <b>12</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.6</b> | <b>2.8</b> | <b>2</b>   | <b>2.4</b> | <b>2.4</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |



**Core Paper VI –  
ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY**

| Subject Code              | L  | T | P | S | Credits | Instructional<br>Hours | Marks |                         |       |
|---------------------------|--|---|---|---|---------|------------------------|-------|-------------------------|-------|
|                           |  |   |   |   |         |                        | CIA   | External                | Total |
| 23U5BTC07                 | 5  | 1 |   |   | 5       | 6                      | 25    | 75                      | 100   |
| <b>Learning Objective</b> |  |   |   |   |         |                        |       |                         |       |
| <b>LO1</b>                | Know about the environment, its issues and management of the environment.  |   |   |   |         |                        |       |                         |       |
| <b>LO2</b>                | Explain the process of waste water treatment, drinking water treatment and solid waste management in various industries.   |   |   |   |         |                        |       |                         |       |
| <b>LO3</b>                | Illustrate the significance of bioreactors in bioprocess engineering and culture methods.  |   |   |   |         |                        |       |                         |       |
| <b>LO4</b>                | Explain Downstream processing, Fermented Products production and advanced methods  |   |   |   |         |                        |       |                         |       |
| <b>LO5</b>                | Speculate the role and importance of microorganisms behind the ore leaching, production of food products and Biofertilizers.   |   |   |   |         |                        |       |                         |       |
| <b>UNIT</b>               | <b>Contents</b>  |   |   |   |         |                        |       | <b>No. of<br/>Hours</b> |       |
| <b>I</b>                  | Environmental Pollution – Sources and types - Water, Air, Thermal, Industrial and Radiation - Global environmental changes. Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.       |   |   |   |         |                        |       | 15                      |       |
| <b>II</b>                 | Waste water treatment: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management. Bioenergy and SCP from waste. Drinking water treatment. Biotechnological approach to industrial effluent (Paper, Tannery, Textile) Pesticide waste disposal. |   |   |   |         |                        |       | 15                      |       |

|                   |   |    |
|-------------------|---|----|
| III               | Bioprocess Engineering-Steps in bioprocess development. Design of bioreactors - Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenters. Fermentation systems Batch culture, Continuous culture, Fed-batch culture,                        | 15 |
| IV                | Downstream processing Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing. Different types of fermented foods produced from microorganisms- Idli, Sauerkraut - Dairy products- Cheese and Yoghurt. Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips -Types and applications. Microbial Polysaccharide production: Xanthan, Dextran. | 15 |
| V                 | Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - streptomycin. Alcoholic beverages: Wine, Beer – Biofertilizers- Rhizobium & Azotobacter. Biopesticides – <i>Bacillus thuringiensis</i> and microbial toxin production and their applications - Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids.   | 15 |
| Total             |   | 75 |
| <b>Text Books</b> |   |    |
| 1                 | Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi.  |    |
| 2                 | Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International, New Delhi.   |    |
| 3                 | Murugesan, A G., Rajakumari, C., 2005. Environmental Science and Biotechnology Theory and Techniques., MJP publishers, Chennai.   |    |
| 4                 | T.Satyanarayana, Bhavdish Narain Johri, Anil Prakash (2012), Microorganisms in Sustainable Agriculture and Biotechnology.   |    |
| 5                 | Madigan, Michael and Martinko, John, Brock biology of microorganism, 11th edition, (2005).  |    |

| <b>Reference Books</b> |   |
|------------------------|---|
| 1                      | Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,   |
| 2                      | Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, Elsevier Science Ltd   |
| 3                      | Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton (2001.), Industrial Microbiology: An Introduction. . Blackwell Science Ltd  |
| 4                      | Nduka Okafor, Modern Industrial Biotechnology & Microbiology ()2017, Science Publishers, Edenbridge Ltd.  |
| 5                      | Waites, Morgan, Rockey and Higton, Industrial Microbiology: An Introduction, Blackwell Science (2001).  |
| <b>Web Resources</b>   |   |
| 1                      | <a href="https://nptel.ac.in/courses/120/108/120108004/">https://nptel.ac.in/courses/120/108/120108004/</a>   |
| 2                      | <a href="https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&amp;%20J%20C%20Furlong.pdf">https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&amp;%20J%20C%20Furlong.pdf</a> |
| 3                      | <a href="http://www.Prenhall.com/Madigan">www. Prenhall.com/Madigan</a>   |
| 4                      | <a href="http://www.e-bug.eu/">www.e-bug.eu/</a>  |
| 5                      | <a href="http://www.microbeworld.org/">www.microbeworld.org/</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          | 3          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 3          | 3          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 2          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>13</b>  | <b>14</b>  | <b>11</b>  | <b>13</b>  | <b>12</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.6</b> | <b>2.8</b> | <b>2.2</b> | <b>2.6</b> | <b>2.4</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |

**Elective I –  
NANO BIOTECHNOLOGY**

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |           |              |
|---------------------------|---|---|---|---|---------|---------------------|-------|-----------|--------------|
|                           |   |   |   |   |         |                     | CIA   | External  | Total        |
| 23U5BTE01                 | 3   | 1 |   |   | 3       | 4                   | 25    | 75        | 100          |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |           |              |
| LO1                       | The students will get an outline about Nano biotechnology and its research in India.  |   |   |   |         |                     |       |           |              |
| LO2                       | To know about nanoparticles and their analysis using Advanced Instrumentation.  |   |   |   |         |                     |       |           |              |
| LO3                       | To get an insight about Nano devices  |   |   |   |         |                     |       |           |              |
| LO4                       | The students will know about the Applications of Nano biotechnology   |   |   |   |         |                     |       |           |              |
| LO5                       | The students will know about the Nano Biosensors and their applications.  |   |   |   |         |                     |       |           |              |
| UNIT                      | Contents  |   |   |   |         |                     |       |           | No. of Hours |
| I                         | Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.               |   |   |   |         |                     |       |           | 15           |
| II                        | Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM   |   |   |   |         |                     |       |           | 15           |
| III                       | Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells-Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.          |   |   |   |         |                     |       |           | 15           |
| IV                        | Agriculture: Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system. |   |   |   |         |                     |       |           | 15           |
| V                         | Nano biosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car).   |   |   |   |         |                     |       |           | 15           |
| <b>Total</b>              |   |   |   |   |         |                     |       | <b>75</b> |              |

| <b>Text Books</b>      |   |
|------------------------|---|
| 1                      | Vasantha Pattabhi and N. Gautham (2009), Biophysics, Narosa Publishing House, New Delhi.  |
| 2                      | Narayanan.P (2010), Essentials of Biophysics, New Age International (P) Ltd. Publishers, New Delhi.   |
| 3                      | Rai, Mahendra, and Clemens Posten (2013). <i>Green biosynthesis of nanoparticles: Mechanisms and applications</i> , CABI, ISBN: 9781780642246.                                  |
| 4                      | Shanmugam.S, "Nanotechnology", MJP publishers, 2010.  |
| 5                      | Pradeep T (2012). <i>Textbook of Nanoscience and Nanotechnology</i> , McGraw Hill publications, ISBN: 9781259007323.  |
| <b>Reference Books</b> |   |
| 1                      | D.Voet & J.G.Voet (2010), Biochemistry, John Wiley & Sons, New York.  |
| 2                      | Biochemistry by Lubert Stryer, 4 <sup>th</sup> Ed., WH.Freeman, 1995.   |
| 3                      | David S. Goodsell, "Bionanotechnology", John Wiley & Sons Inc., publications, 2004.   |
| 4                      | Guozhong Cao (2004). Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial College Press, ISBN: 978-1860944802.                                    |
| 5                      | C.M.Niemeyer, C.A. Mirkin (2007). <i>Nanobiotechnology</i> , WILEY-VCH Verlag GmbH & Co. KG, Weinheim, ISBN: 9783527306589.   |
| <b>Web Resources</b>   |   |
| 1                      | <a href="http://vvm.org.in/study_material/ENG%20-20Indian%20Contributions%20to%20Science">http://vvm.org.in/study_material/ENG%20-20Indian%20Contributions%20to%20Science</a> . |
| 2                      | <a href="https://www.jabonline.in/admin/php/uploads/16_pdf.pdf">https://www.jabonline.in/admin/php/uploads/16_pdf.pdf</a>   |
| 3                      | <a href="https://www.youtube.com/watch?v=gSpHINVmgoE">https://www.youtube.com/watch?v=gSpHINVmgoE</a>   |
| 4                      | <a href="https://www.youtube.com/watch?v=ITtGJUGXFKc">https://www.youtube.com/watch?v=ITtGJUGXFKc</a>   |
| 5                      | <a href="https://www.youtube.com/watch?v=4cGROrskvLM">https://www.youtube.com/watch?v=4cGROrskvLM</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          | 2          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 3          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 2          | -          | -          | 2          | 3           | 2           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>13</b>  | <b>13</b>  | <b>9</b>   | <b>10</b>  | <b>13</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.6</b> | <b>2.6</b> | <b>1.8</b> | <b>2</b>   | <b>2.6</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |

**Elective I –**  
**ENZYMOLGY**

| Subject Code              | L   | T | P | S | Credits | Instructional<br>Hours | Marks |          |                 |
|---------------------------|---|---|---|---|---------|------------------------|-------|----------|-----------------|
|                           |   |   |   |   |         |                        | CIA   | External | Total           |
| 23U5BTE02                 | 3   | 1 |   |   | 4       | 4                      | 25    | 75       | 100             |
| <b>Learning Objective</b> |   |   |   |   |         |                        |       |          |                 |
| LO1                       | The students will learn the Fundamentals of Enzymology.   |   |   |   |         |                        |       |          |                 |
| LO2                       | The students will study about the characteristic features of Enzymes.   |   |   |   |         |                        |       |          |                 |
| LO3                       | The student will know about the details of Enzyme Kinetics.   |   |   |   |         |                        |       |          |                 |
| LO4                       | The student will apply the biochemical techniques for enzyme isolation  |   |   |   |         |                        |       |          |                 |
| LO5                       | The Student will understand the process of Immobilization of enzymes, Enzyme engineering and Designer enzymes in various Industrial purposes.   |   |   |   |         |                        |       |          |                 |
| UNIT                      | Contents  |   |   |   |         |                        |       |          | No. of<br>Hours |
| <b>I</b>                  | Nomenclature and classification of enzymes according to the International Union of Biochemistry and Molecular Biologists Convention. Properties of enzymes and factors that influence rate of enzyme action (pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors). Definitions - Apoenzyme, holoenzyme, zymogens. Coenzymes – (Vitamin and Non vitamin origin). Transition state theory, standard free energy, activation energy. |   |   |   |         |                        |       |          | 15              |
| <b>II</b>                 | Active site (definition, characteristic features), Enzyme specificity. Bisubstrate and multisubstrate reactions. ES complex formation, lock and key model and induced fit model. Enzyme units - IU & Katal. Turnover number. Isoenzymes (LDH & CPK), Definition – Ribozymes & Abzymes.  |   |   |   |         |                        |       |          | 15              |
| <b>III</b>                | Enzyme Kinetics – Michaelis-Menten equation and its derivation, significance of Km and Vmax, Lineweaver- Burk plot and Eadie- Hofstee plot, Hanes-Woolf plot. Enzyme inhibition - competitive, Non- competitive, Uncompetitive – (Derivations not included). Allosteric inhibition - sequential model, concerted model, feedback inhibition.  |   |   |   |         |                        |       |          | 15              |
| <b>IV</b>                 | Membrane bound proteins – Fluid mosaic model. Extraction of enzymes – Chemical agents and Physical methods of extraction, French pressure cell and ultrasonication. Nature of the extraction medium. Technique for enzyme isolation, separation of cellular organelles by differential centrifugation, purification of enzymes- dialysis, chromatography, electrophoresis. Intracellular localization of enzymes and marker enzymes.                                    |   |   |   |         |                        |       |          | 15              |



|                        |  |          |
|------------------------|--|----------|
| V                      | Immobilization of enzymes- Chemical and Physical methods. Clinical and industrial applications of immobilized enzymes. Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes. | 15       |
|                        |  | Total 75 |
| <b>Text Books</b>      |  |          |
| 1                      | Satyanarayana. U. 2013. Biochemistry.4 <sup>th</sup> edition, Elsevier India.  |          |
| 2                      | Jain J L, 2014, Fundamentals of Biochemistry, 7 <sup>th</sup> edition, S.Chand publishing.   |          |
| 3                      | Rodwell, V.W, Bender D.A, Botham K.M. 2015, Harper's Illustrated Biochemistry, 30 <sup>th</sup> edition. McGraw-Hill Education.  |          |
| 4                      | Fundamentals of Enzymology - Nicholas C. Price and Lewis Stevens., Oxford University Press, New Delhi.   |          |
| 5                      | Voet, D. and Voet, J.G. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,  |          |
| <b>Reference Books</b> |  |          |
| 1                      | Enzyme – Palmer, 18th edition, 2004.London: Portland Press   |          |
| 2                      | Biochemistry- Jeremy M Berg, John L Tymoczko, and LubertStryer,6th Edition, Freeman Publications, 2006.  |          |
| 3                      | Ralph A. Messing (2012) Immobilised Enzymes Academic Press, NY.  |          |
| 4                      | Nelson D.L., and Cox, M.M. 2013. Lehninger Principles of Biochemistry. 6 <sup>th</sup> edition.W.H. Freeman & Company.   |          |
| 5                      | Jeremy M Berg, Stryer, L. 2015. Biochemistry, 8 <sup>th</sup> edition. Macmillan Learning.   |          |
| <b>Web Resources</b>   |  |          |
| 1                      | <a href="https://www.youtube.com/watch?v=AD3-v1oKjSk">https://www.youtube.com/watch?v=AD3-v1oKjSk</a>  |          |
| 2                      | <a href="https://www.youtube.com/watch?v=tPCOEUo6J8s">https://www.youtube.com/watch?v=tPCOEUo6J8s</a>  |          |
| 3                      | <a href="https://www.youtube.com/watch?v=ALwziZSRiqM">https://www.youtube.com/watch?v=ALwziZSRiqM</a>  |          |
| 4                      | <a href="https://www.youtube.com/watch?v=0ZiCqwtFMTs">https://www.youtube.com/watch?v=0ZiCqwtFMTs</a>  |          |
| 5                      |  |          |

**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          | 2          | 1          | 3          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 3          | 3          | 2          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 3          | 2          | 1          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 2          | 2          | 3          | 2          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 2          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | <b>15</b>  | <b>14</b>  | <b>14</b>  | <b>10</b>  | <b>10</b>  | <b>13</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.8</b> | <b>2.8</b> | <b>2</b>   | <b>2</b>   | <b>2.6</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |

**Elective I-  
BIOETHICS & BIOSAFETY**

| SubjectCode               | L   | T        | P | S | Credits  | Instructional<br>Hours | Marks     |           |                         |
|---------------------------|---|----------|---|---|----------|------------------------|-----------|-----------|-------------------------|
|                           |   |          |   |   |          |                        | CIA       | External  | Total                   |
| <b>23U5BTE03</b>          | <b>3</b>  | <b>1</b> |   |   | <b>4</b> | <b>4</b>               | <b>25</b> | <b>75</b> | <b>100</b>              |
| <b>Learning Objective</b> |   |          |   |   |          |                        |           |           |                         |
| LO1                       | The students will understand the concepts of Bioethics and Biosafety.   |          |   |   |          |                        |           |           |                         |
| LO2                       | The students will realize the impact of Gene cloning in societal problems and also understand the need of the Bioethics.  |          |   |   |          |                        |           |           |                         |
| LO3                       | The students will know about the importance of Ethical Clearance.   |          |   |   |          |                        |           |           |                         |
| LO4                       | The students will get knowledge about Patents Rights in the field of Research.  |          |   |   |          |                        |           |           |                         |
| LO5                       | The students will know about Biosafety and GLP.   |          |   |   |          |                        |           |           |                         |
| <b>UNIT</b>               | <b>Contents</b>   |          |   |   |          |                        |           |           | <b>No. of<br/>Hours</b> |
| 1                         | Human Rights: Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.  |          |   |   |          |                        |           |           | <b>15</b>               |
| II                        | Impact of gene cloning & Bioethics-Issues concerning reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion).   |          |   |   |          |                        |           |           | <b>15</b>               |
| III                       | Bioethics of IPR - ethical criteria in biotechnology- animal ethics; Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects.   |          |   |   |          |                        |           |           | <b>15</b>               |
| IV                        | Patents - Introduction -Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability – Non Patentable Inventions - Patent Application Procedure in India. Other Forms of IP: Copyright - Trade Mark – Industrial designs – Farmer’s Rights. Patenting of Biotechnology products and processes. |          |   |   |          |                        |           |           | <b>15</b>               |

|                        |  |           |
|------------------------|--|-----------|
| V                      | Biosafety - General guidelines - DBT guidelines on biosafety in conducting research in biology / biotechnology - Risk assessment studies- Hazardous materials used in Biotechnology- Handling and Disposal - Good manufacturing practices & Good Laboratory practices, Containment facilities and Biosafety practices - Regulation on field experiments and release of GMO's - Labelling of GM foods - Guidelines for research in transgenic plants and Animals. | <b>15</b> |
| <b>Total</b>           |  | <b>75</b> |
| <b>Text Books</b>      |  |           |
| 1                      | Ignacimuthu, S (2009), <i>Bioethics</i> , Narosa Publication house, ISBN: 978-81-7319-966-0  |           |
| 2                      | V. Sree Krishna . V (2007), <i>Bioethics and Biosafety in Biotechnology</i> , (1st ed.), New Age International Private Limited.  |           |
| 3                      | Rhona Smith. (2003), <i>International Human rights</i> , Blackstone Press.   |           |
| 4                      | Manual of patent practice and procedure. IPR India, 2005.  |           |
| 5                      | Ministry of commerce and industry, New Delhi, pp.163.  |           |
| <b>Reference Books</b> |  |           |
| 1                      | Trayer, P.C, Fredrick.R., and Koch, M. (2002), <i>Biosafety</i> . Michigan State University  |           |
| 2                      | Biosafety, Traylor, Fredric & Koch, 2002. Michigan state University pub., USA.   |           |
| 3                      | Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co.Belmont, California.   |           |
| 4                      | Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333   |           |
| <b>Web Resources</b>   |  |           |
| 1                      | <a href="http://www.ipr-helpdesk.org/">www.ipr-helpdesk.org/</a>   |           |
| 2                      | <a href="http://www.patentoffice.nic.in/ipr/patent/patents.htm">www.patentoffice.nic.in/ipr/patent/patents.htm</a>   |           |
| 3                      | <a href="http://www.bangalorebio.com/GovtInfo/ipr.htm">www.bangalorebio.com/GovtInfo/ipr.htm</a>   |           |



**Elective I –  
CANCER BIOLOGY**

| SubjectCode               | L  | T        | P | S | Credits  | Instructional<br>Hours | Marks     |              |                        |
|---------------------------|--|----------|---|---|----------|------------------------|-----------|--------------|------------------------|
|                           |  |          |   |   |          |                        | CIA       | External     | Total                  |
| <b>23U5BTE04</b>          | <b>3</b>   | <b>1</b> |   |   | <b>4</b> | <b>4</b>               | <b>25</b> | <b>75</b>    | <b>100</b>             |
| <b>Learning Objective</b> |  |          |   |   |          |                        |           |              |                        |
| LO1                       | The students will understand the Basics of Cancer Biology.   |          |   |   |          |                        |           |              |                        |
| LO2                       | The students will comprehend the Cancer at the Molecular level.  |          |   |   |          |                        |           |              |                        |
| LO3                       | The students will learn about the types of Cancer.   |          |   |   |          |                        |           |              |                        |
| LO4                       | The students will realize the different techniques of Detection and Treatment of Cancer.   |          |   |   |          |                        |           |              |                        |
| LO5                       | The students will know about the Prevention of Cancer.   |          |   |   |          |                        |           |              |                        |
| <b>UNIT</b>               | <b>Contents</b>  |          |   |   |          |                        |           |              | <b>No.of<br/>Hours</b> |
| I                         | Cancer: Introduction; Origin of Cancer- The Mutation Concept, The Epigenetic Concept, Viral Concept, Unified genetic concept of cancer; Difference between Normal and Cancer cells; Signs and symptoms.  |          |   |   |          |                        |           |              | 15                     |
| II                        | Cancer as a genetic disease; Genetic Alterations in Cancer cells, Point mutation, splice mutation, alternate splicing; Mutation in regulatory sequences, deletions, Insertion, Chromosome abnormalities, Genetic defects and the time course of hereditary cancer. |          |   |   |          |                        |           |              | 15                     |
| III                       | Types of Cancer: - Blood & Lymph – Leukemia, Malignant lymphoma, Bone-Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumor suppressor genes; Classification of Tumor suppressor genes.            |          |   |   |          |                        |           |              | 15                     |
| IV                        | Detection and Treatment:- Early detection, Molecular detection of Carcinomas, Cancer warning signals; Markers in blood urine; Therapies- Chemotherapy, Gene therapy, Radiotherapy, Biological therapy( Immuno therapy).  |          |   |   |          |                        |           |              | 15                     |
| V                         | Prevention:- Tobacco smoking, sunlight, diet, ionizing radiation, alcohol drugs, promiscuity, lifestyle and cancer prevention, Environmental factors and cancer, potentially carcinogenic substances for humans.   |          |   |   |          |                        |           |              | 15                     |
|                           |  |          |   |   |          |                        |           | <b>Total</b> | <b>75</b>              |

| <b>Text Books</b>      |   |
|------------------------|---|
| 1                      | A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.  |
| 2                      | Ranajit Sen, 2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.   |
| 3                      | Dr M.R.Ahuja, 1997, Cancer- Causes and Prevention, UBS Publishers Distributors Pvt. Ltd.  |
| 4                      | A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.  |
| 5                      | Ranajit Sen, 2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.   |
| <b>Reference Books</b> |   |
| 1                      | Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press  |
| 2                      | Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.  |
| 3                      | Robin Hesketh, 2012, Introduction to Cancer Biology, Cambridge University Press   |
| 4                      | Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press  |
| 5                      | Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.  |
| <b>Web Resources</b>   |   |
| 1                      | <a href="http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf">http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf</a> |
| 2                      | <a href="http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm">http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm</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          | 3          | 3          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 3          | 3          | 3          | 2          | 3          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 3          | 3          | 3          | 3          | 3           | 3           | 3           |
| <b>TOTAL</b>   | 15         | 15         | 15         | 15         | 14         | 15         | 15          | 15          | 15          |
| <b>AVERAGE</b> | 3          | 3          | 3          | 3          | 2.8        | 3          | 3           | 3           | 3           |



**CORE PRACTICAL V-  
PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY**

| Subject Code               | L   | T | P | S | Credits | Instructional<br>Hours | Marks |           |                 |
|----------------------------|---|---|---|---|---------|------------------------|-------|-----------|-----------------|
|                            |   |   |   |   |         |                        | CIA   | External  | Total           |
| 23U5BTCP05                 | -   | - | 4 |   | 2       | 4                      | 25    | 75        | 100             |
| <b>Learning Objectives</b> |   |   |   |   |         |                        |       |           |                 |
| LO1                        | Explain plant tissue culture and Illustrate Callus development.   |   |   |   |         |                        |       |           |                 |
| LO2                        | Develop technical skills in Protoplast isolation and Nucleus localization.  |   |   |   |         |                        |       |           |                 |
| LO3                        | Make use of the techniques used in preparing tissue culture medium and membrane filtration in culturing animal cells and prepare single cell suspension and evaluate cell counting and viability. |   |   |   |         |                        |       |           |                 |
| LO4                        | Develop technical skills in isolation of DNA and RNA from plants and microorganisms.  |   |   |   |         |                        |       |           |                 |
| LO5                        | Examine the importance of trypsinization in monolayer and subculture and cryopreservation.  |   |   |   |         |                        |       |           |                 |
| UNIT                       | Contents  |   |   |   |         |                        |       |           | No. of<br>Hours |
| <b>I</b>                   | Plant tissue culture media preparation & sterilization techniques.<br>Callus induction  |   |   |   |         |                        |       |           | <b>9</b>        |
| <b>II</b>                  | Isolation of plant protoplast & viability test.<br>Localization of nucleus using nuclear stain.   |   |   |   |         |                        |       |           | <b>9</b>        |
| <b>III</b>                 | Preparation of Animal Tissue culture medium and membrane filtration<br>Preparation of Single Cell Suspension & Cell counting<br>Cell viability Test   |   |   |   |         |                        |       |           | <b>9</b>        |
| <b>IV</b>                  | Isolation of plant DNA and plant RNA(Demo)<br>Isolation of Agrobacterium plasmid DNA (Demo)   |   |   |   |         |                        |       |           | <b>9</b>        |
| <b>V</b>                   | Trypsinization of monolayer and subculturing (Demo)<br>Measurement of phagocytic activity (Demo)<br>MTT Assay (Demo)<br>Cryopreservation and thawing (Demo)                                       |   |   |   |         |                        |       |           | <b>9</b>        |
| <b>Total</b>               |   |   |   |   |         |                        |       | <b>45</b> |                 |
| <b>Text Books</b>          |   |   |   |   |         |                        |       |           |                 |
| 1                          | Madhavi Adhav, 2009, Practical Biotechnology and Plant Tissue Culture, S.Chand & Company Ltd.   |   |   |   |         |                        |       |           |                 |

|                        |   |
|------------------------|---|
| 2                      | C. C. Giri, Archana Giri, 2007, Plant Biotechnology: Practical Manual, I.K. International Pvt Ltd.  |
| 3                      | Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009, Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application, Springer.   |
| 4                      | Debajit Borah (2018), <i>Environmental Biotechnology Theory and Lab Practices</i> , (2nd edition), Hardcover – Global Vision Publishing House, ISBN: 9788182205840                                |
| <b>Reference Books</b> |   |
| 1                      | S. Lal, Vikas. (2018), <i>Public Health Management Principles And Practice</i> , (2nd Edition), CBS Publishers and Distributors Pvt Ltd, ISBN 13: 9789387742932                                   |
| 2                      | S. Harisha. (2012), <i>Biotechnology procedures and experiments handbook</i> , ISBN13 9781934015117   |
| <b>Web Resources</b>   |   |
| 1                      | <a href="https://www.plantcelltechnology.com/pct-blog/different-types-of-tissue-culture-processes/">https://www.plantcelltechnology.com/pct-blog/different-types-of-tissue-culture-processes/</a> |
| 2                      | <a href="https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html">https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html</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          | 2          | -          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 2          | 2          | 2          | -          | 2          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 3          | 2          | 2          | -          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 3          | 2          | -          | 2          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 3          | 2          | 1          |            | 2          | 3           | 3           | 3           |
| <b>TOTAL</b>   | 15         | 13         | 12         | 9          | -          | 10         | 15          | 15          | 15          |
| <b>AVERAGE</b> | 3          | 2.6        | 2.5        | 1.9        | -          | 2          | 3           | 3           | 3           |

**CORE PRACTICAL VI –  
ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY**

| SubjectCode               | L   | T | P | S | Credits | Instructional<br>Hours | Marks |                        |       |
|---------------------------|---|---|---|---|---------|------------------------|-------|------------------------|-------|
|                           |   |   |   |   |         |                        | CIA   | External               | Total |
| <b>23U5BTC06</b>          | -   | - | 4 | - | 2       | 4                      | 25    | 75                     | 100   |
| <b>Learning Objective</b> |   |   |   |   |         |                        |       |                        |       |
| LO1                       | Students can able to isolate the microorganisms and determine their growth curve, generationtime.   |   |   |   |         |                        |       |                        |       |
| LO2                       | To analyze the water samples, perform immobilization and production of Wine, Biogas andcompost.   |   |   |   |         |                        |       |                        |       |
| LO3                       | Develop skills in bio fertilizer production and microbial identification.   |   |   |   |         |                        |       |                        |       |
| LO4                       | Gain basic skills to analyze raw milk and determine the pasteurization efficacy.  |   |   |   |         |                        |       |                        |       |
| LO5                       | Develop skills to perform efficiency tests of biofertilizers and biopesticides, microbialpolysaccharide production.   |   |   |   |         |                        |       |                        |       |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                        |       | <b>No.of<br/>Hours</b> |       |
| I                         | Isolation of Air borne Pathogens<br>Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.  |   |   |   |         |                        |       | 9                      |       |
| II                        | Water analysis – MPN and BOD.<br>Immobilization of whole yeast cells/ enzyme by Alginate beads.Production of wine<br>Production of Biogas – <i>In vitro</i> & Compost Making.     |   |   |   |         |                        |       | 9                      |       |
| III                       | Biofertilizer production/Spirulina production - field visit. (Report should beincluded in the record)<br>Isolation and identification of starter organisms from Idli batter/ curd |   |   |   |         |                        |       | 9                      |       |
| IV                        | Grading of raw milk (Dye reduction test).<br>Determination of efficiency of Pasteurization by quantitative phosphatase test.  |   |   |   |         |                        |       | 9                      |       |
| V                         | Preparation and Efficiency testing of Biofertilizer/<br>Biopesticide. (Demo)Production of microbial Polysaccharide.<br>(Demo)   |   |   |   |         |                        |       | 9                      |       |
|                           |   |   |   |   |         |                        | Total | 45                     |       |
|                           |   |   |   |   |         |                        |       |                        |       |

| <b>Text Books</b>      |   |
|------------------------|---|
| 1                      | Aneja K R, <i>Laboratory Manual of Microbiology and Biotechnology</i> , MEDTECH, 2014.ISBN-13 : 978-9381714553  |
| 2                      | Vijaya Ramesh, (2007), <i>Food Microbiology</i> , MJP Publishers, Chennai, ISBN-13 : 978-8180940194   |
| <b>Reference Books</b> |   |
| 1                      | Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed., (1983), <i>A Manual of Laboratory Techniques</i> , National Institute of Nutrition, ICMR, Hyderabad. |
| <b>Web Resources</b>   |   |
| 1                      | <a href="https://www.youtube.com/watch?v=3UafRz3QeO8">https://www.youtube.com/watch?v=3UafRz3QeO8</a>   |
| 2                      | <a href="https://www.youtube.com/watch?v=jpuNYpvBmDM">https://www.youtube.com/watch?v=jpuNYpvBmDM</a>   |
| 3                      | <a href="https://www.youtube.com/watch?v=tUCfkNKyQyc">https://www.youtube.com/watch?v=tUCfkNKyQyc</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          | 3          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO2</b>    | 3          | 2          | 3          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO3</b>    | 3          | 2          | 3          | 2          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO4</b>    | 3          | 2          | 3          | 1          | 2          | 2          | 3           | 3           | 3           |
| <b>CLO5</b>    | 3          | 2          | 3          | 1          | 2          | 2          | 3           | 3           | 3           |
| <b>TOTAL</b>   | 15         | 10         | 15         | 8          | 10         | 10         | 15          | 15          | 15          |
| <b>AVERAGE</b> | 3          | 2          | 3          | 1,6        | 2          | 2          | 3           | 3           | 3           |

**SEMESTER- VI**

**Core Paper VIII - BIOENTREPRENEURSHIP**

| Subject Code              | L   | T        | P | S | Credits  | Instructional Hours | Marks     |           |                    |
|---------------------------|---|----------|---|---|----------|---------------------|-----------|-----------|--------------------|
|                           |   |          |   |   |          |                     | CIA       | External  | Total              |
| <b>23U6BTC06</b>          | <b>4</b>  | <b>1</b> |   |   | <b>5</b> | <b>5</b>            | <b>25</b> | <b>75</b> | <b>100</b>         |
| <b>Learning Objective</b> |   |          |   |   |          |                     |           |           |                    |
| LO1                       | Students will be able to identify the challenges of being a Bioentrepreneur   |          |   |   |          |                     |           |           |                    |
| LO2                       | Will understand the Business proposal for starting a company  |          |   |   |          |                     |           |           |                    |
| LO3                       | Will learn about Vermicomposting and Sericulture  |          |   |   |          |                     |           |           |                    |
| LO4                       | Will aspire to set up Mushroom Cultivation  |          |   |   |          |                     |           |           |                    |
| LO5                       | Will learn the technique of Single cell protein Cultivation   |          |   |   |          |                     |           |           |                    |
| <b>UNIT</b>               | <b>Contents</b>   |          |   |   |          |                     |           |           | <b>No.of Hours</b> |
| I                         | Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations – Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India) |          |   |   |          |                     |           |           | <b>15</b>          |
| II                        | Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. Market Conditions, Identifying the need of the customers.  |          |   |   |          |                     |           |           | <b>15</b>          |
| III                       | Vermicomposting – Earthworms – Ecological types - Vermiculture- Compostpit – Vermibed - applications. Sericulture – Mulberry cultivation - Silkworm Rearing – Economics of silk worm Production - Chawki Rearing-Sericulture in India.  |          |   |   |          |                     |           |           | <b>15</b>          |
| IV                        | Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting; Mushroom diseases, Medicinal and Nutritional properties of mushroom. Aquaponics- Systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.               |          |   |   |          |                     |           |           | <b>15</b>          |
| V                         | Single Cell Protein Production: Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: SPIRULINA Cultivation – Production site, Microorganism, Experimental design; harvesting and Drying.  |          |   |   |          |                     |           |           | <b>15</b>          |

|                        |  |           |
|------------------------|--|-----------|
| <b>Total</b>           |  | <b>75</b> |
| <b>Text Books</b>      |  |           |
| 1                      | Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.   |           |
| 2                      | Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge. |           |
| 3                      | The Earthworm book, Ismail, S.A., other India Press, Goa   |           |
| 4                      | An Introduction to sericulture by G.Ganga, J.Sulochana Chetty.   |           |
| 5                      | Silk: Processing, Properties and Applications Book by K. Murugesh Babu   |           |
| <b>Reference Books</b> |  |           |
| 1                      | Adams, D. J., & Sparrow, J. C. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.                                |           |
| 2                      | Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.  |           |
| 3                      | Desai, V. The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.  |           |
| 4                      | The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Rusell      |           |
| 5                      | Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava  |           |
| <b>Web Resources</b>   |  |           |
| 1                      | <a href="https://archive.india.gov.in/citizen/agriculture">https://archive.india.gov.in › citizen › agriculture</a>  |           |
| 2                      | <a href="http://www.recirculatingfarms.org/resources/">http://www.recirculatingfarms.org/resources/</a>  |           |
| 3                      | <a href="https://academy.vertical-farming.net/intro-to-mushroom-growing/">https://academy.vertical-farming.net/intro-to-mushroom-growing/</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>    | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>3</b>   | <b>2</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>3</b>   | <b>2</b>   | <b>2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>    | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>2</b>   | <b>2</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>2</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>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>TOTAL</b>   | <b>15</b>  | <b>13</b>  | <b>10</b>  | <b>14</b>  | <b>10</b>  | <b>13</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>2.6</b> | <b>2</b>   | <b>2.8</b> | <b>2</b>   | <b>2.6</b> | <b>3</b>    | <b>3</b>    | <b>3</b>    |



**Core Paper IX –  
PHARMACEUTICAL BIOTECHNOLOGY**

| SubjectCode               | L  | T | P | S | Credits | Instructional<br>Hours | Marks |              |                |
|---------------------------|--|---|---|---|---------|------------------------|-------|--------------|----------------|
|                           |  |   |   |   |         |                        | CIA   | External     | Total          |
| 23U6BTC07                 | 4  | 1 |   |   | 5       | 5                      | 25    | 75           | 100            |
| <b>Learning Objective</b> |  |   |   |   |         |                        |       |              |                |
| LO1                       | Students will understand the series of processes involved in drug development, patenting and drug approval.  |   |   |   |         |                        |       |              |                |
| LO2                       | Will learn about Biopharmaceuticals  |   |   |   |         |                        |       |              |                |
| LO3                       | Will become familiar with Biotech protein drugs  |   |   |   |         |                        |       |              |                |
| LO4                       | Will understand about management of drugs  |   |   |   |         |                        |       |              |                |
| LO5                       | Will be familiar with Pharmaceutical sectors   |   |   |   |         |                        |       |              |                |
| UNIT                      | Contents   |   |   |   |         |                        |       |              | No.of<br>Hours |
| <b>I</b>                  | Objectives of Pharmaceutical Biotechnology - Generic and Biogeneric drugs. Stages in the drug development process -Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials.                                     |   |   |   |         |                        |       |              | <b>15</b>      |
| <b>II</b>                 | Production of recombinant proteins - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy .   |   |   |   |         |                        |       |              | <b>15</b>      |
| <b>III</b>                | Human Insulin (Humulin), Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides ( $\beta$ - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab). |   |   |   |         |                        |       |              | <b>15</b>      |
| <b>IV</b>                 | Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management   |   |   |   |         |                        |       |              | <b>15</b>      |
| <b>V</b>                  | National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors.   |   |   |   |         |                        |       |              | <b>15</b>      |
|                           |  |   |   |   |         |                        |       | <b>Total</b> | <b>75</b>      |

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



**Elective II –  
MARINE BIOTECHNOLOGY**

| Subject Code              | L  | T        | P | S | Credits  | Instructional<br>Hours | Marks     |           |                         |
|---------------------------|--|----------|---|---|----------|------------------------|-----------|-----------|-------------------------|
|                           |  |          |   |   |          |                        | CIA       | External  | Total                   |
| <b>23U6BTE05</b>          | <b>3</b>   | <b>1</b> |   |   | <b>4</b> | <b>4</b>               | <b>25</b> | <b>75</b> | <b>100</b>              |
| <b>Learning Objective</b> |  |          |   |   |          |                        |           |           |                         |
| LO1                       | Students will gain knowledge about Marine Ecosystem and Resources.   |          |   |   |          |                        |           |           |                         |
| LO2                       | Will learn about bioactive compounds from Marine sources   |          |   |   |          |                        |           |           |                         |
| LO3                       | Will learn about medicinal seaweeds  |          |   |   |          |                        |           |           |                         |
| LO4                       | Will know about culture of seaweeds and Aquaculture  |          |   |   |          |                        |           |           |                         |
| LO5                       | Will know about Marine biotech products  |          |   |   |          |                        |           |           |                         |
| <b>UNIT</b>               | <b>Contents</b>  |          |   |   |          |                        |           |           | <b>No. of<br/>Hours</b> |
| I                         | Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea- Euphotic- Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.              |          |   |   |          |                        |           |           | 15                      |
| II                        | Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture. |          |   |   |          |                        |           |           | 15                      |
| III                       | Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.  |          |   |   |          |                        |           |           | 15                      |
| IV                        | Culture aspect-Seaweed ( <i>Kappaphycus alvarezii</i> ), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Trangenesis and Cryopreservation.            |          |   |   |          |                        |           |           | 15                      |
| V                         | Products from marine sources. Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.  |          |   |   |          |                        |           |           | 15                      |

|                        |  |           |
|------------------------|--|-----------|
| <b>Total</b>           |  | <b>75</b> |
| <b>Text Books</b>      |  |           |
| 1                      | Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.  |           |
| 2                      | Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.  |           |
| 3                      | Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.  |           |
| 4                      | David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.   |           |
| 5                      | Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience                                       |           |
| <b>Reference Books</b> |  |           |
| 1                      | Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York                     |           |
| 2                      | Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp  |           |
| 3                      | Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp  |           |
| 4                      | Gloria Sanchez, Elizabeth Hernandez,(2019), <i>Environmental Biotechnology and cleaner Bioprocess</i> , (1 <sup>st</sup> edition), CRC Press, ISBN 9780367455552 |           |
| <b>Web Resources</b>   |  |           |
| 1                      | <a href="http://coe.genomics.org.cn/">http://coe.genomics.org.cn/</a>  |           |
| 2                      | <a href="http://www.bcb.iastate.edu/">http://www.bcb.iastate.edu/</a>  |           |
| 3                      | <a href="http://www.nwfsc.noaa.gov/protocols/bioinformatics.html">http://www.nwfsc.noaa.gov/protocols/bioinformatics.html</a>                                    |           |
| 4                      | <a href="http://www.ebi.ac.uk/ ExPASy.org/">http://www.ebi.ac.uk/ ExPASy.org/</a>  |           |
| 5                      | <a href="http://www.expasy.org/">http://www.expasy.org/</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>    | <b>3</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>CLO2</b>    | <b>3</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>CLO3</b>    | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>1</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>2</b>   | <b>1</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO5</b>    | <b>3</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>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>13</b>  | <b>5</b>   | <b>10</b>  | <b>15</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>3</b>   | <b>2,6</b> | <b>1</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |

**Elective II-  
FOOD TECHNOLOGY**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |             |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|-------------|
|                           |  |   |   |   |         |                     | CIA   | External | Total       |
| 23U6BTE06                 | 3  | 1 |   |   | 4       | 4                   | 25    | 75       | 100         |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |             |
| LO1                       | Students will be able to understand the basic concepts of the food industry  |   |   |   |         |                     |       |          |             |
| LO2                       | Will learn about classification of food  |   |   |   |         |                     |       |          |             |
| LO3                       | Will learn about fruits, vegetables and horticulture   |   |   |   |         |                     |       |          |             |
| LO4                       | Will learn about Non vegetarian food   |   |   |   |         |                     |       |          |             |
| LO5                       | Will learn about food adulteration and biosensors to detect them   |   |   |   |         |                     |       |          |             |
| UNIT                      | Contents   |   |   |   |         |                     |       |          | No.of Hours |
| <b>I</b>                  | Biotechnology relating to the food industry – Role of bioprocess engineering in biotechnology industry- Regulatory and social aspects of biotechnology in foods- Application of biotechnology in waste treatment of food industries. Historical evolution of food processing technology.   |   |   |   |         |                     |       |          | <b>15</b>   |
| <b>II</b>                 | Cereals and Millets. Wheat- composition, types (hard, soft/ strong, weak). Malting, gelatinization of starch, types of browning- Maillard & caramelization. Rice- and composition, parboiling of rice- advantages and disadvantages. Structure and composition of pulses, toxic constituents in pulses, processing of pulses soaking, germination, decortications, cooking and fermentation. Fats and Oils. Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation. Rancidity – Types- hydrolytic and oxidative rancidity and its prevention. |   |   |   |         |                     |       |          | <b>15</b>   |
| <b>III</b>                | Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre. Post-harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.   |   |   |   |         |                     |       |          | <b>15</b>   |

|                        |  |           |
|------------------------|--|-----------|
| <b>IV</b>              | Concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. Aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish - microbiological, physiological and biochemical. Composition and nutritive value of egg, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers. Milk and Milk Products. Chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products. | <b>15</b> |
| <b>V</b>               | Types of food adulterants – test to detect adulterants in foods – metal contaminants - contaminants of processed foods- Food products as analytical samples, general aspects of biosensors- biosensors for food contaminant analysis, commercially available biosensors for food analysis. Food additives, FSSAI regulations, Methods of fortifying and enriching foods.   | <b>15</b> |
| <b>Total</b>           |  | <b>75</b> |
| <b>Text Books</b>      |  |           |
| 1                      | Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013.   |           |
| 2                      | B. Srilakshmi, Food science, New Age Publishers,2002   |           |
| 3                      | Joshi, V.K. and Singh, R.S., A. (2013), <i>Food Biotechnology- Principles and practices</i> , I.K.International Publishing House Pvt. Ltd., New Delhi,.  |           |
| 4                      | RavishankarRai, V,( 2015), <i>Advances in Food Biotechnology</i> , (First edition), John Wiley & Sons, Inc, ISBN 9781118864555.  |           |
| 5                      | Perry Johnson-Green.( 2018), <i>Introduction to Food Biotechnology</i> , Special Indian Edition, <i>CRC Press</i> , ISBN 9781315275703.  |           |
| <b>Reference Books</b> |  |           |
| 1                      | Roday,S. Food Science, Oxford publication, 2011.   |           |
| 2                      | Meyer, Food Chemistry, New Age,2004 5. De Sukumar., <i>Outlines of Dairy Technology</i> , Oxford University Press, 2007  |           |
| 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                    | Roday,S. <i>Food Science</i> , Oxford publication, 2011.  |
| <b>Web Resources</b> |   |
| 1                    | <a href="https://ifst.onlinelibrary.wiley.com/journal/13652621">https://ifst.onlinelibrary.wiley.com/journal/13652621</a>   |
| 2                    | <a href="https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27">https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27</a> |
| 3                    | <a href="https://www.springer.com/journal/13197">https://www.springer.com/journal/13197</a>   |
| 4                    | <a href="https://www.sciencedirect.com/referencework/9780081005965/food-science">https://www.sciencedirect.com/referencework/9780081005965/food-science</a>   |
| 5                    | <a href="https://www.ift.org/news-and-publications/food-technology-magazine">https://www.ift.org/news-and-publications/food-technology-magazine</a>   |

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

|                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 |
|----------------|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CLO1</b>    | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |
| <b>CLO2</b>    | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |
| <b>CLO3</b>    | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |
| <b>CLO4</b>    | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |
| <b>CLO5</b>    | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |
| <b>TOTAL</b>   | 15  | 10  | 5   | 5   | 10  | 10  | 15   | 15   | 15   |
| <b>AVERAGE</b> | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 3    | 3    |

**Elective III –  
MEDICAL BIOTECHNOLOGY**

| Subject Code              | L  | T        | P | S | Credits  | Instructional Hours | Marks     |           |                     |
|---------------------------|--|----------|---|---|----------|---------------------|-----------|-----------|---------------------|
|                           |  |          |   |   |          |                     | CIA       | External  | Total               |
| <b>23U6BTE07</b>          | <b>3</b>   | <b>1</b> |   |   | <b>4</b> | <b>4</b>            | <b>25</b> | <b>75</b> | <b>100</b>          |
| <b>Learning Objective</b> |  |          |   |   |          |                     |           |           |                     |
| LO1                       | Student will be able to obtain knowledge on Vaccines, Antibody therapy and Diagnostics   |          |   |   |          |                     |           |           |                     |
| LO2                       | Will know the Molecular basis of diseases  |          |   |   |          |                     |           |           |                     |
| LO3                       | Will know about cytokines and interferons  |          |   |   |          |                     |           |           |                     |
| LO4                       | Will learn about clinical trials   |          |   |   |          |                     |           |           |                     |
| LO5                       | Will learn about ethics in clinical trials   |          |   |   |          |                     |           |           |                     |
| <b>UNIT</b>               | <b>Contents</b>  |          |   |   |          |                     |           |           | <b>No. of Hours</b> |
| I                         | Antibodies and vaccines - Therapeutic production of antibodies, antibody mediated drug delivery of vaccines, different kind of vaccines and applications of recombinant vaccines. Diagnosis - Biochemical diagnostics, inborn errors of metabolism, haemoglobinopathies. |          |   |   |          |                     |           |           | <b>15</b>           |
| II                        | Molecular basis of disease, Recombinant DNA Technology in medicine, gene probes as molecular diagnostic reagents. Polymerase Chain Reaction in clinical diagnostics, DNA sequencing of representative clones to detect mutations.  |          |   |   |          |                     |           |           | <b>15</b>           |
| III                       | Diagnosis of infectious diseases, Viral diseases – HIV, influenza; bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays. FACs immunocytochemical staining, ELISA, FISH techniques.   |          |   |   |          |                     |           |           | <b>15</b>           |
| IV                        | Immunoblot analysis of antigens and allergens. Production of therapeutic agents – Productions and application of therapeutic agents, Production of cytokines and interferons.  |          |   |   |          |                     |           |           | <b>15</b>           |

|                        |   |           |
|------------------------|---|-----------|
| V                      | Principles of project management in Clinical trials and its application. Principles of research ethics; Ethical issues in clinical trials; Animal rights and use of animals in the advancement of medical technology. Use of humans in Scientific Experiments; Introduction to ethical codes and conduct. | <b>15</b> |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | Roli, M. (2017). <i>National Ethical Guidelines for Biomedical and Health Research Involving Human Participants</i> , ISBN: 978-81-910091-94  |           |
| 2                      | Lela, B. and Maribeth, L. F. (2011). <i>Molecular Diagnostics: Fundamentals, Methods and Clinical Applications</i> , (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775  |           |
| 3                      | <i>Clinical Applications</i> , (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775  |           |
| <b>Reference Books</b> |   |           |
| 1                      | Bernard, R. G. Terry, L.D. and Cheryl, L.P. (2014). <i>Medical Biotechnology</i> , (2 <sup>nd</sup> edition).   |           |
| 2                      | Patrick, R.M. Kenneth, S.R. and Michael, A.P. (2016). <i>Medical Microbiology</i> , (8 <sup>th</sup> edition). USA. Elsevier Publishers, eBook ISBN: 9780323388504  |           |
| 3                      | Pamela, G. Michelle, M, (2009). <i>Molecular Therapeutics: 21st century medicine</i> , (1st Edition). Hoboken, New Jersey. Wiley Publishers.  |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/</a>   |           |
| 2                      | <a href="https://www.nature.com/articles/s41577-021-00542-x">https://www.nature.com/articles/s41577-021-00542-x</a>   |           |
| 3                      | <a href="https://www.ncbi.nlm.nih.gov/books/NBK26837/">https://www.ncbi.nlm.nih.gov/books/NBK26837/</a>   |           |
| 4                      | <a href="https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing">https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing</a>   |           |
| 5                      | <a href="http://aquafind.com/articles/Elisa.php">http://aquafind.com/articles/Elisa.php</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>    | <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>3</b>    |
| <b>CLO2</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>3</b>    |
| <b>CLO3</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>3</b>    |
| <b>CLO4</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>3</b>    |
| <b>CLO5</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>3</b>    |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>10</b>  | <b>15</b>  | <b>15</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>Average</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>3</b>    |

**Elective III-  
FORENSIC BIOTECHNOLOGY**

| Subject Code              | L   | T | P | S | Credits | Instructional<br>Hours | Marks |           |                |
|---------------------------|---|---|---|---|---------|------------------------|-------|-----------|----------------|
|                           |   |   |   |   |         |                        | CIA   | External  | Total          |
| 23U6BTE08                 | 3   | 1 |   |   | 4       | 4                      | 25    | 75        | 100            |
| <b>Learning Objective</b> |   |   |   |   |         |                        |       |           |                |
| LO1                       | Students will gain insight into Forensic Biotechnology.   |   |   |   |         |                        |       |           |                |
| LO2                       | Will know about various investigations protocol   |   |   |   |         |                        |       |           |                |
| LO3                       | Will know about blood related issues  |   |   |   |         |                        |       |           |                |
| LO4                       | Will know the use of molecular approaches to investigation  |   |   |   |         |                        |       |           |                |
| LO5                       | Will understand DNA fingerprinting  |   |   |   |         |                        |       |           |                |
| UNIT                      | Contents  |   |   |   |         |                        |       |           | No.of<br>Hours |
| I                         | Definition and scope of Forensic Biotechnology, History and development, Forensic genetics, Forensic agriculture.   |   |   |   |         |                        |       |           | 15             |
| II                        | Crime scene investigation; collection, preservation, packing and forwarding of physical and trace evidence. Questioned documents – identification of handwriting, signature and detection of forgery.   |   |   |   |         |                        |       |           | 15             |
| III                       | Serology - Fresh blood grouping and typing, stains of bloods. Identification of blood stains, collection and storage of allied body fluids (semen, saliva and blood). Bones, Teeth and cloth materials and crime scene materials. Case studies. |   |   |   |         |                        |       |           | 15             |
| IV                        | PCR, RT-PCR, Fluorimetry, RFLP, AFLP, Microscopy (Electron, Fluorescent) and Chromatography (Paper, TLC & HPLC) in forensic investigation.  |   |   |   |         |                        |       |           | 15             |
| V                         | DNA Profiling, Isolation of DNA from blood samples, DNA testing in cases of disputed paternity and maternity.   |   |   |   |         |                        |       |           | 15             |
| <b>Total</b>              |   |   |   |   |         |                        |       | <b>75</b> |                |
| <b>Text Books</b>         |   |   |   |   |         |                        |       |           |                |

|                        |   |
|------------------------|---|
| 1                      | Nageshkumar G Rao, Textbook of Forensic Medicine & Toxicology, Jaypee, 2013.  |
| 2                      | K.S. Narayan reddy and O.P. Murty, The Essentials of Forensic Medicine & Toxicology, 35th Edition, Jaypee, 2017.  |
| 3                      | Nanda, B.B. and Tiwari R. K. (2014). Forensic Science in India: A Vision for the Twenty First Century, (2 <sup>nd</sup> edition), Select Publishers, New Delhi, ISBN: 9788190113526.  |
| 4                      | Barbara H. Stuart (2013). Forensic Analytical Techniques (Analytical Techniques in the Sciences (AnTs), (1 <sup>st</sup> edition), UK, Wiley, ISBN: 978-0-470-68727-7.  |
| 5                      | C. Champod, C. Lennard, C. Margot, P. and Stoilovic (2015). Fingerprints and other Ridge Skin Impressions, (7 <sup>th</sup> edition), Boca Raton, CRC Press, ISBN: 9781498728959.   |
| <b>Reference Books</b> |   |
| 1                      | Jim Fraser, " Forensic Science: A very short introduction", Oxford university press, 2010.  |
| 2                      | William Goodwin, Adrian Linacre, SibteHadi, "An introduction to Forensic Genetics", John Wiley & Sons Ltd 2007.   |
| 3                      | Harralson H. and Miller S. (2017). <i>Huber and Headrick's Handwriting Identification: Facts and Fundamentals</i> , (2nd Edition), Boca Raton, CRC Press, ISBN: 9781498751308.  |
| 4                      | Ghosal S. and Avasthi A.S. (2018). <i>Fundamentals of Bioanalytical Techniques and Instrumentation</i> , (2nd Edition), Delhi, PHI, ISBN: 9789387472396.  |
| <b>Web Resources</b>   |   |
| 1                      | <a href="http://www.forensicsciencesimplified.org">http://www.forensicsciencesimplified.org</a>   |
| 2                      | <a href="http://www.nfstc.org">www.nfstc.org</a>  |
| 3                      | <a href="https://archive.org/details/FBI_Handbook_of_ForensicScience">https://archive.org/details/FBI_Handbook_of_ForensicScience</a>   |
| 4                      | <a href="https://www.soinc.org/forensics-notes">https://www.soinc.org/forensics-notes</a><br><a href="http://www.forensicbiology.com">www.forensicbiology.com</a><br><a href="http://www.medicinalforensicscience.com">www.medicinalforensicscience.com</a><br><a href="http://www.forsicmedicine.com">www.forsicmedicine.com</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>    | <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>3</b>    |
| <b>CLO2</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>3</b>    |
| <b>CLO3</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>3</b>    |
| <b>CLO4</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>3</b>    |
| <b>CLO5</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>3</b>    |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>10</b>  | <b>15</b>  | <b>15</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</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>3</b>    |

**Elective III**  
**GOOD LABORATORY PRACTICES (GLP)**

| Subject Code              | L  | T | P | S | Credits | Instructional Hours | Marks |          |              |
|---------------------------|--|---|---|---|---------|---------------------|-------|----------|--------------|
|                           |  |   |   |   |         |                     | CIA   | External | Total        |
| 23U6BTE09                 | 3  | 1 |   |   | 4       | 4                   | 25    | 75       | 100          |
| <b>Learning Objective</b> |  |   |   |   |         |                     |       |          |              |
| LO1                       | The student will know the types of labs associated with Biotechnology  |   |   |   |         |                     |       |          |              |
| LO2                       | Will know to use and maintain lab Instruments  |   |   |   |         |                     |       |          |              |
| LO3                       | Will know the calculations needed in a laboratory  |   |   |   |         |                     |       |          |              |
| LO4                       | Will know about good lab Guidelines  |   |   |   |         |                     |       |          |              |
| LO5                       | Will know how to safely dispose bio waste  |   |   |   |         |                     |       |          |              |
| UNIT                      | Contents   |   |   |   |         |                     |       |          | No. of Hours |
| 1                         | Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique. |   |   |   |         |                     |       |          | 15           |
| II                        | Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).   |   |   |   |         |                     |       |          | 15           |
| III                       | Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation.   |   |   |   |         |                     |       |          | 15           |



|                        |   |           |
|------------------------|---|-----------|
| IV                     | Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.  | 15        |
| V                      | Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel. | 15        |
| <b>Total</b>           |   | <b>75</b> |
| <b>Text Books</b>      |   |           |
| 1                      | WHO training manual on Good Laboratory Practices, 2 <sup>nd</sup> Edition.  |           |
| <b>Reference Books</b> |   |           |
| 1                      | Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.   |           |
| <b>Web Resources</b>   |   |           |
| 1                      | <a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "tdr  |           |
| 2                      | <a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> ">publications documents  |           |
| 3                      | <a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "glp  |           |
| 4                      | <a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "-trainer   |           |
| 5                      | <a href="http://www.who.int/tdr/publications/documents/glp-handbook.pdf">www.who.int/tdr/publications/documents/glp-handbook.pdf</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>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO2</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO3</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</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>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CLO5</b>    | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>TOTAL</b>   | <b>15</b>  | <b>15</b>  | <b>15</b>  | <b>10</b>  | <b>10</b>  | <b>15</b>  | <b>15</b>   | <b>15</b>   | <b>15</b>   |
| <b>AVERAGE</b> | <b>3</b>   | <b>3</b>   | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>3</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    |

## SKILL BASED PAPER FOR COMPETITIVE EXAMINATION

| Subject Code              | L   | T | P | S | Credits | Instructional Hours | Marks |          |                     |
|---------------------------|---|---|---|---|---------|---------------------|-------|----------|---------------------|
|                           |   |   |   |   |         |                     | CIA   | External | Total               |
|                           | 3   | 1 |   |   | 4       | 4                   | 25    | 75       | 100                 |
| <b>Learning Objective</b> |   |   |   |   |         |                     |       |          |                     |
| <b>LO1</b>                | Ability to use numbers at an appropriate level of accuracy  |   |   |   |         |                     |       |          |                     |
| <b>LO2</b>                | Develops skills of analysis and critical evaluation   |   |   |   |         |                     |       |          |                     |
| <b>LO3</b>                | Identifies the Sentence Rearrangement, Antonyms and Synonyms. Error Detection. Idioms and Phrases   |   |   |   |         |                     |       |          |                     |
| <b>LO4</b>                | Ability to learn the patterns and techniques to solve the questions   |   |   |   |         |                     |       |          |                     |
| <b>LO5</b>                | Develops knowledge in various issues of country   |   |   |   |         |                     |       |          |                     |
| <b>UNIT</b>               | <b>Contents</b>   |   |   |   |         |                     |       |          | <b>No. of Hours</b> |
| <b>I</b>                  | <b>SERIES COMPLETION:</b> Number Series. Alphabet Series, Alpha Numeric Series, Continuous Pattern Series. <b>ANALOGY:</b> Completing the Analogous Pair, Direct Analogy, Double Analogy, Multiple word Analogy, Number Analogy and Alphabet analogy. <b>CLASSIFICATION:</b> Choosing the odd word, Choosing the odd Pair of words, Choosing the odd Numeral word, Choosing the odd Numeral Pair of words, Choosing the odd Letter Group. |   |   |   |         |                     |       |          | <b>15</b>           |
| <b>II</b>                 | <b>Coding and Decoding-</b> Letter Coding, Direct Letter Coding, Number /Symbol Coding, Matrix Coding, Substitution, Deciphering Message Word Codes, Deciphering Number and Symbol Codes for Messages and Jumbled Coding. <b>Blood Relations:</b> deciphering jumbledup Descriptions, Relation Puzzle, Coded Relations. Family based Puzzles and Jumbled Problems.  |   |   |   |         |                     |       |          | <b>15</b>           |
| <b>III</b>                | <b>Verbal Ability-</b> Reading Comprehension. Cloze Test. Sentence earrangement. Antonyms and Synonyms. Error Detection. Idioms and Phrases, One- word substitution, Word analogy, Resume writing   |   |   |   |         |                     |       |          | <b>10</b>           |
| <b>IV</b>                 | <b>ARITHMETICAL REASONING-</b> Calculation based Problems, Data Based Questions, Problems On Ages, Venn Diagram based Questions. Inserting Missing Character, Data Sufficiency, Assertion and Reason, Situation Reaction Test and Verification of Truth of the Statement.   |   |   |   |         |                     |       |          | <b>10</b>           |

|              |  |           |
|--------------|--|-----------|
| <b>V</b>     | <b>General Awareness and Current Affairs.</b><br>Indian Polity and Governance, Economic and Social Development, General issues on Environmental Ecology, Biodiversity, and Climate Change, General Science, Current events of national and international | <b>15</b> |
| <b>Total</b> |  | <b>65</b> |

| <b>TEXT BOOKS</b> |  |
|-------------------|--|
| <b>1.</b>         | A Modern Approach to VERBAL REASONING – Dr, R.S AGGARWAL. S CHAND and Company Limited (AN ISO 9001:2008 COMPANY) Ram Nagar, NEW DELHI-110055, ISBN:978-93-5283-217-0                         |
| <b>2</b>          | Upkars Current Genral knowledge current affairs and who is who?  |
| <b>3</b>          | General English for all competitive exams by S.C.Guptha  |
| <b>4</b>          | How to Crack Test Of Reasoning -Verbal, analytical and non-verbal reasoning-Jai Kishan, Premkishan importance, History of India and the Indian National Movement, Indian and World Geography |

**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>3</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>3</b>   | <b>3</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>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>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>  |

**NON-MAJOR ELECTIVES (NME)**

1. Food and Nutrition
2. Herbal Medicine
3. Public Health and Hygiene
4. Environment Management in Industries
5. Good Laboratory Practices
6. Organic Farming and Health Management
7. Biotechnology for Society
8. Computational Biology

**NON-MANDATORY SUBJECTS**

1. Food and bioprocess technology
2. Food chemistry
3. Mushroom cultivation
4. Global climate change
5. Aquaculture
6. Vermitechnology
7. Poultry science and management
8. Basics in research methodology
9. Clinical nutrition and dietary management
10. Cryobiology

## **FOOD AND BIOPROCESS TECHNOLOGY**

### **Course Outcome**

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

### **UNIT I**

Introduction to Bioprocess Technology: History and Scope- Bioreactor: Design, parts and accessories, functions- Modes of Operation of fermenter – Batch & continuous - Types of reactors - Bubble column, Fluidized bed reactor, plug flow reactor.

### **UNIT II**

Fermentation media design, sterilization and media requirement for industrial fermentation, Main parameters to be monitored and controlled in fermentation processes, aerobic and anaerobic fermentation processes. Development and scale up of bioreactors for production of biological products. Immobilization – Types of immobilization, various methods - Applications of immobilized enzyme technology.

### **UNIT III**

Downstream processing: Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods. Enrichment operations: Membrane – based separations. Product finishing: precipitation/crystallization, mixing, dialysis, distillation and drying.

### **UNIT IV**

Production of microbial enzymes (Amylase, Protease and Pectinase) applications, production of organic solvents (Ethanol, Methanol) – production of organic acids (Citric acid, Acetic acid) - Single cell protein production – Spirulina, Yeast, Actinomycetes protein. Beverages production – Beer and Wine.

### **UNIT V**

Processing of Milk – Pasteurization and homogenization - Modifying milk composition – Production of milk products – Curd, cheese, yogurt, and flavoured milk. Bakery products – Bread making. Probiotics and Role of Food technology in bio-defense programs.

### **References:**

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

**FOOD CHEMISTRY****Course outcome:**

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

**Unit – I:**

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of Wheat, Rice, Milk, Butter etc. with clay stones, water and toxic chemicals - Common adulterants. Common adulterants Ghee adulterants and their detection. Detection of adulterated Foods by simple analytical techniques.

**Unit – II:**

Food Poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion)- Chemical poisons - First aid for Poison consumed victims.

**Unit – III:**

Food additives - artificial sweeteners- Saccharin - Cyclamate and aspartame. Food flavours - esters, aldehydes and heterocyclic compound. Food colours - Emulsifying agents-preservatives - leavening agents. Baking powder - yeast - taste makers - MSG vinegar.

**Unit – IV:**

Beverages - soft drinks - soda - fruit juices - alcoholic beverages. Carbonation - addiction to alcohol - diseases of liver and social problems.

**Unit – V:**

Fats, Oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases - determination of iodine value, RM value, saponification values and their significance.

**References:**

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



## 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.

## **GLOBAL CLIMATE CHANGE**

### **Course outcome:**

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

### **Unit – I:**

Global Environmental change issues. UNFCCC, IPCC, Kyoto protocol, CDM, Carbon foot print and ecological foot print.

### **Unit – II:**

Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts for mitigation ozone layer depletion.

### **Unit – III:**

Climate change: Greenhouse effects; causes; Greenhouse gases and their sources; Consequences on climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.

### **Unit – IV:**

Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.

### **Unit – V:**

Acid rain and its effects on plants, animals, microbes and ecosystems.

### **References:**

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

## **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

## **VERMITECHNOLOGY**

### **Course outcome:**

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

### **Unit – I:**

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

### **Unit – II:**

Culturing techniques of earthworms and composting materials General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.

### **Unit – III:**

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

### **Unit – IV:**

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

### **Unit – V:**

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

### **References:**

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

## **POULTRY SCIENCE AND MANAGEMENT**

### **Course outcome:**

Students will understand the domestication of fowls, techniques of rearing and management of various breed. They will acquire knowledge on the diseases of poultry and the prophylactic measures.

### **Unit – I:**

External features of fowls – skeletal system – digestive system – endocrine system – feathers – Respiratory system – reproductive system. Genetics of fowls: Breeds of fowls – inheritance of morphological characters (List of autosomal and sex linked character – breeding methods – systems of breeding – modern method of breeding.

### **Unit – II:**

Poultry industry in India– choosing commercial layers and broilers – Poultry housing – deep litter and cage system-merits and demerits.

### **Unit – III:**

Practical aspects of chick rearing –brooding management- grower and layers – management of broilers – lighting, summer winter management – debunking.

### **Unit – IV:**

Poultry Nutrition: Energy – protein and aminoacids – Vitamins – essential organic elements – Non – nutrition feed additives – feed stuffs for poultry – feed formation.

### **Unit – V:**

Diseases: Viral, bacterial, fungal and parasitic disease. Vaccines and vaccination programmes.

### **References:**

1. Gopalakrishnan C.A and G.Murley Mohan Lal 1997, Livestock and Poultry enterprises for rural development, Vikash, New Delhi.
2. Gnaanamani M.R., 1998 Modern aspects of commercial poultry keeping, Giri.
3. Banarjee G.C., 1992 Poultry, Oxford and IBH, New Delhi.
4. Chauhan H.V.S. and S.Roy, Poultry diseases, diagnosis and treatment New Age International, 1996.
5. John William S. (Ed) 2003. Poultry for sustainable Food Production and livelihood. Loyola Publication, Chennai.

## **BASICS IN RESEARCH METHODOLOGY**

### **Course outcome:**

This course aims to inculcate a clear idea of research among students, understand the existing social issues in research, frame hypothesis, design the wet lab procedures and interpret the results.

### **Unit-I:**

Objectives, Motivation to perform research. Types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

### **Unit-II:**

Basic concepts of Statistical sampling methods, Sample Size, Sampling Frame, Sampling Error, Characteristics of a good sample, Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages)

### **Unit –III:**

Research Question & Investigation Question, Hypothesis, Qualities of a good Hypothesis, Features of a good research design, Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

### **UNIT IV:**

Layout of a Research Paper, Journals in Life Science, Impact factor of Journals, Ethical issues related to publishing: Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

### **UNIT V:**

Methods to search required information effectively, Reference Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Softwares for detection of Plagiarism.

### **References:**

1. Research Methods for the Biosciences. Holmes, Moody & Dine. Oxford University Press.
2. Experimental Design for the Life Sciences. Ruxton & Colegrave. Oxford University Press.
3. C.R.Kothari Research methodology.
4. Robert A. Day (1998), How to Write & Publish a Scientific Paper. Oryx Press; 5 editions
5. Frank D. Bell (1995), Basic Biostatistics: Concepts for the Health Sciences. William C. Brown
6. Judith Bell. Doing your research, A guide for first-time researchers in education, health, and social science. 4<sup>th</sup> edition. Open University press. McGraw Hill education (2005).
7. <https://explorable.com/quantitative-research-design>

## CLINICAL NUTRITION AND DIETARY MANAGEMENT

### Course outcome:

On completion of the course, the students will understand the need for a Balanced diet, gain insight on Nutrition requirements during different stages of Life. Appreciate the importance of Dietary Management in different diseases. Acquire knowledge on different modes of nutrition

### Unit–I:

Definition of Nutrition, Overview of Balanced diet, Collecting and analyzing Nutritional information – Physical examination, Anthropometric measurements.

### Unit–II:

Common food allergies, food intolerance – lactose intolerance. Cardiovascular diseases- atherosclerosis, and myocardial infarction, foods that increase LDL and HDL.

### Unit–III:

Bulimia and Anorexia Nervosa. Dietary management with reference to Constipation, Diarrhoea, Dehydration, Peptic Ulcer, Hepatitis, Gall bladder diseases and Renal failure.

### Unit–IV:

Dietary management with reference to Hypertension, Diabetes Mellitus, AIDS and Cancer, Surgery and Nutritional support, outline of Enteral Nutrition and Parenteral Nutrition.

### References:

1. Garrow, JS , James WPT and Ralph A (2000) . Human nutrition and Dietetics (10th ed) Churchill Livingston.
2. PiareyLal Mehta, NeenaVerma, P I Mehta (1999) Human Rights Under the Indian Constitution. Deep & Deep Publications Pvt. Ltd.
3. Handbook of Food and Nutrition –Dr. M. Swaminathan, BappcoPubisher,2014.
4. Nutrition Science- B.Srilakshmi,7<sup>th</sup> edition, New age International Publisher, 2017.
5. William’s Basic Nutrition and Diet Therapy – Staci Nix McIntosh,First South Asian Edition, Elsevier Publisher, 2016.
6. Nutrition essentials and diet therapy-Packenpough,11<sup>th</sup>edition,Saunders Publishers, 2009.
7. Davidson’s Principles and Practice of Medicine – Sir Stanley Davidson, 21st edition, Elsevier Publishers, 2010

## **CRYOBIOLOGY**

### **Course Outcomes:**

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

### **Unit-I**

Introduction to Cryobiology, cryopreservation - natural cryopreservation , temperature, risks, slow, permeable freezing, vitrification, uses freezable tissues, equipment, limitations.

### **Unit-II**

Liquid nitrogen – uses, safety, production; glass transition- introduction, transition temperature  $T_g$ , kausmann's paradox, the glass transition, specific materials, silica, polymers, mechanism of vitrification, electronic structures; ex-situ conservation; cryoprotectants; cryostasis; neuropreservation.

### **Unit-III**

Cryopreservation in nature – antifreeze protein, antifreeze, psychrophile, insect winter ecology, cryogenic treatment, cryogenic seal, cryogenic fuel, energy storage, crystal, cryotank, absolute zero, target temperature management.

### **Unit-IV**

Hibernation, heterothermy, hibernaculum, hypothermia, chilblains, frost bite, trench feet, thermoregulation.

### **Unit-V**

Application of Cryobiology - cloning, molecular cloning, organ transplantation, sperm bank, semen extender, in-vitro fertilization, embryo transfer, cryosurgery, cryoablation.

## **REFERENCE**

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