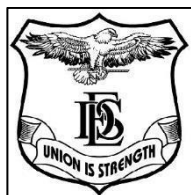


Deccan Education Society's

# Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)



Affiliated to

## UNIVERSITY OF MUMBAI

Syllabus for

Program: Bachelor of Science

Course: F.Y.Bsc

Subject: **Biotechnology**

Choice Based Credit System (CBCS)

with effect from

Academic Year 2024-2025

| <b>Semester</b> | <b>Course Code</b>                       | <b>Course Title</b>                                                               | <b>Vertical</b> | <b>Credit</b> |
|-----------------|------------------------------------------|-----------------------------------------------------------------------------------|-----------------|---------------|
| <b>I</b>        | 24BTMJ111                                | Fundamentals of Biotechnology-I                                                   | Major           | 2             |
|                 | 24BTMJ112                                | Molecular Biology and Genetics -2                                                 | Major           | 2             |
|                 | 24BTMJ111                                | Practical-1(Fundamentals of Biotechnology+Molecular Biology and genetics)         | Major           | 2             |
|                 | 24BTOE131                                | Food Technology                                                                   | OE              | 2             |
|                 | 24BTVC141                                | Wine Technology                                                                   | VSC             | 2             |
|                 | 24BTSC151                                | Microbial Culture Techniques                                                      | SEC             | 2             |
| <b>II</b>       | 24BTMJ211                                | Fundamentals of Biotechnology-2                                                   | Major           | 2             |
|                 | 24BTMJ212                                | Cell biology Physiology and Immunology                                            | Major           | 2             |
|                 | 24BTMJ211                                | Practical-2 (Fundamentals of biotechnology-2 +Cell biology,physiology,immunology) | Major           | 2             |
|                 | 24BTMRC221/<br>24BTMRM221/<br>24BTMRL221 | Chemistry/<br>Microbiology/ Life Science                                          | Minor           | 2             |
|                 | 24BTVC241                                | Analytical Instrumentation Techniques                                             | VSC             | 2             |
|                 | KU23USBTSC251                            | Crop improvement strategies, Composting and Solid waste management                | SEC             | 2             |

## **PROGRAM OUTCOMES**

| <b>PO</b>                                                                        | <b>Description</b>                                                                                                                                                                        |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A student completing Bachelor's Degree in <b>Science</b> Program will be able to |                                                                                                                                                                                           |
| PO1                                                                              | Understand scope and applications of Biotechnology and its interdisciplinary approach.                                                                                                    |
| PO2                                                                              | Understand Fundamentals of Biotechnology.<br>Acquire and Demonstrate Comprehensive knowledge and good experimental and Laboratory skills in Biotechnology                                 |
| PO3                                                                              | Build strong Knowledge and conceptual learning through systematic thinking and self -study.                                                                                               |
| PO4                                                                              | Understand and apply appropriate tools and techniques in Biotechnology<br>Acquire the knowledge of upcoming fields of Biotechnology, make the learner competent to pursue higher studies. |
| PO5                                                                              | Acquire an ability to analyse and scientific problems and develop scientific research ability                                                                                             |
| PO6                                                                              | Learn appropriate skills in conduction of Biotechnological experiments<br>learn good oral and written communication skills as well as nurturing creativity                                |
| PO7                                                                              | Employe skill and knowledge in environmental management and sustainable development<br>Impart skills and Knowledge in designing entrepreneurial courses in the field of biotechnology.    |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                             | MAJOR-I SEM – I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Credits           | Lectures/<br>Week |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 24BTMJ111                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Paper I<br>Fundamentals of biotechnology-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2                 | 2                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>• To acquaint students with various fields of Biotechnology and their applications</li> <li>• To Understand the applications of biotechnology in the field of agriculture, health care, Human welfare, fermentation industry and Environment</li> <li>• To analyse Scope of the Biotechnology in different industry.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | No of<br>Lectures |                   |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Scope and Introduction to Biotechnology</b><br><br><b>Biotechnology</b> –an interdisciplinary biological science;<br>Biotechnology – definition;<br>History & Introduction to Biotechnology;<br>Traditional and Modern Biotechnology;<br>Scope and importance of biotechnology;<br>World of Biotechnology- Pharmaceutical Biotechnology, Plant Biotechnology, Industrial Biotechnology, Marine Biotechnology, Animal Biotechnology, Medical Biotechnology, Environmental Biotechnology.<br>Biotechnology in India – bio-business in India, booming biotech market, success story of biotech market, policy initiatives; and global trends;<br>Biotechnology research in India;<br>Potential of modern biotechnology<br>Achievement of biotechnology; Prevention of misuse of biotechnology; Biotechnology Institutions in India (Public and Private Sector); Public Perception of Biotechnology.<br>Case study: Serum Institute of India and its products | 15                |                   |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| II | <p><b>Applications of Biotechnology and fermentation technology</b></p> <p><b>1.Agriculture –GM fruits</b><br/> GM papaya, GM tomato<br/> Insect resistant transgenic plants – Bt cotton, Btbrinjal<br/> Modifications in nutrient quality – starch, oil, seed protein, golden rice</p> <p><b>2.Human welfare</b><br/> <b>Cloned genes for production of -Insulin; recombinant vaccine for Hepatitis B virus.</b><br/> Molecular farming<br/> Edible vaccines and their advantages</p> <p><b>Case study: Genetically modified microbes for bioremediation of oil spills in marine environment</b></p> <p><b>Introduction: Marine Biotechnology introduction</b></p> <p><b>Introduction to fermentation processes</b><br/> <b>Screening:</b> Definition<br/> Primary screening and its methods<br/> Secondary screening and its methods<br/> <b>Fermenter design:</b><br/> Definition of a fermenter<br/> Aerated stirred tank batch fermenter-Typical design<br/> Construction materials used, aeration and agitation<br/> Temperature control<br/> Foam production and control<br/> pH measurement and control<br/> CO<sub>2</sub> and O<sub>2</sub> control<br/> <b>Fermentation medium:</b><br/> Basic requirements of industrial media<br/> Criteria for use of raw materials in media<br/> Examples of raw materials used<br/> Growth factors<br/> Water<br/> Carbohydrate sources<br/> Protein sources</p> | 15 |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

**Textbooks:**

- A Textbook of Biotechnology by R Chaubey 4<sup>th</sup> edition
- Advanced Biotechnology by R C Dubey 1<sup>st</sup> edition
- Biotechnology, Expanding Horizons by B D Singh, 4<sup>th</sup> edition
- Microbial Technology Microbial Process Volume I Peppler Periman second Edition
- Springer Book of Marine Biotechnology

**Additional References:**

- Stanbury and Whitaker 3rd ed
- Screening- Casida
- Fermenter Design- Nduka Okafor 1<sup>st</sup>ed

| Course Code                                                                                                                                                                                                                                                                                                                                                    | MAJOR-II SEM – I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Credits           | Lectures/<br>Week |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 24BTMJ112                                                                                                                                                                                                                                                                                                                                                      | Paper II Molecular Biology and Genetics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2                 | 2                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>• To understand the Composition and structure of DNA and RNAs</li> <li>• To acquaint students with DNA Replication, Repair and Genetic Engineering.</li> <li>• To learn the concepts of Mendelian Genetics.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                           | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No of<br>Lectures |                   |
| I                                                                                                                                                                                                                                                                                                                                                              | <b>DNA Composition, Chromosome, DNA structure and packing:</b><br><br><b>The Composition and structure of DNA and RNA:</b><br>Nucleotide and Nucleoside, Structure of nucleotides.<br>Structure of DNA.<br>DNA double helix – Watson and Crick’s Model.<br>Structure of RNA. Types of RNA.<br><b>Organization of DNA in chromosome:</b><br>Prokaryotic Chromosomes. Eukaryotic Chromosomes.<br>Histone and Non-histone proteins.<br>Nucleosome Structure.<br>Packaging of DNA into chromosomes.<br>Euchromatin and Heterochromatin.<br>Centromeres and Telomeres | 15                |                   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <p style="text-align: center;"><b>II</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><b>DNA replication and Mutation and repair and fundamentals of genetics:</b><br/> DNA Replication in Prokaryotes<br/> Evidence of Semi-conservative DNA replication-<br/> Meselson and Stahl's experiment<br/> DNA Polymerases and its role,<br/> E. coli Chromosome Replication,<br/> DNA Replication in Eukaryotes<br/> Enzymes and proteins involved in DNA replication<br/> <b>DNA REPAIR</b><br/> Photo reversal, Base Excision Repair, Mismatch Repair.</p> <p><b>Genetics:</b><br/> Basic Terminologies in genetics<br/> <b>Mendelian Genetics:</b><br/> Monohybrid Crosses and Mendel's Principle of Segregation. Representing crosses with a Branch Diagram.<br/> Principle of Segregation: The use of Test crosses.<br/> Dihybrid crosses and Mendel's Principle of Independent Assortment.<br/> Extensions of and Deviations from Mendelian Genetic Principles: Multiple Alleles - ABO Blood groups<br/> Modifications of Dominance Relationships: Incomplete Dominance and Codominance.</p> | <p style="text-align: center;"><b>15</b></p> |
| <p><b>Textbooks:</b></p> <ul style="list-style-type: none"> <li>● iGenetics – A molecular approach Peter J Russell 3rd edition</li> <li>● 2.Biochemistry - U Satyanarayana U.Chakrapani, (2013) 4th edition</li> <li>● 3.Principles of Genetics. E J Gardner, M J Simmons &amp; D Peter Snustad. 8th edition</li> <li>● 4. A Textbook of Biotechnology By R.C. Dube</li> <li>● 5.iGenetics – A molecular approach Peter J Russell 3rd edition.</li> </ul> <p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>● Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications)</li> <li>● Genetics, (2006) Strickberger MW - (Prentice Hall, India) (recombination repair)</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |



| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Practical of Major | Credits | Lectures/<br>Week |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------|-------------------|
| 24BTMJP111                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    | 2       | 4                 |
| <p><b>Course Outcomes:</b></p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> <li>● To learn the concepts and principles of various laboratory and aseptic techniques.</li> <li>● To acquaint students with various microbial culture techniques.</li> <li>● To understand the concept of Genetics and to apply it in various analytical techniques.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |         |                   |
| <p style="text-align: center;"><b>Topics</b></p> <ol style="list-style-type: none"> <li>1. Sterilization of Laboratory Glassware and Media using Autoclave and Hot air oven</li> <li>2. Preparation of media- Nutrient broth and Agar, MacConkey Agar, Sabouraud's Agar</li> <li>3. Isolation and characterization of food fermenting organism from idli batter (Using Bergey's Manual)</li> <li>4. Isolation of Yeasts from the natural environment.</li> <li>5. Study of morphology and colony characteristics of yeasts.</li> <li>6. Estimation of DNA by DPA method.</li> <li>7. Estimation of RNA by Orcinol method</li> <li>8. Qualitative analysis of DNA</li> <li>9. Study of Blood groups ABO in humans.</li> <li>10. Construction of Pedigree charts and Analysis of Human Genetic trait using Pedigree analysis.</li> <li>11. Problems based on Mendelian genetics</li> <li>12. Study of Microscope</li> </ol> |                    |         |                   |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | OPEN ELECTIVE SEM – I Food Technology                                                                                                                                                                                                                                                                                                                                                                                                         | Credits           | Lectures/<br>Week |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 24BTOE131                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Paper I Food Technology                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                 | 2                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>To impart skills about Food technology and Explain the application of biotechnology in the food industry. The learner will be able to understand the role of microbes in fermentation, and to know the important genera of microorganisms associated with food and their characteristics.</li> <li>To introduce the basics of various food processing and preservation technologies. To study the importance microorganisms in food preservation</li> <li>The learner will be able to understand Food regulations (national as well as international) Design and implementation of food safety management systems such as ISO series, Emerging concerns.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                        | No of<br>Lectures |                   |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Introduction To Food Biotechnology, its applications, Fermented Food Products</b><br>History of microorganisms in food science and key developments.<br>Applications of biotechnology in fermented food products - Introduction to Unit Operations and Processes, Food processing & packaging (canning & bottling), Production of cultures.<br>Fermented food products – Bread, Vinegar, Sauerkraut, Single Cell Protein (SCP), Probiotics | 15                |                   |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Food spoilage, Food Preservation, Quality and safety</b><br>Food spoilage, food deterioration and contamination.<br>Methods of food preservation<br>Indicators of Food Microbial Quality & Safety, FSSAI & FDA                                                                                                                                                                                                                             | 15                |                   |

**Textbooks:**

- Food Microbiology, 5 th edition, William C. Frazier, Dennis C. Westhoff, N.M. Vanitha, McGraw Hill Education, India.
- Fundamentals of Food Biotechnology, 2 nd edition, Byong H. Lee, Wiley Blackwell
- Modern Food Microbiology, 7 th edition, James M. Jay, Martin J. Loessner, David A. Golden, Food Science Texts Series
- Prescott's Microbiology, 9 th edition, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw-Hill, USA.
- Industrial Microbiology, A. H. Patel

**Additional References:**

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=15>

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | VOCATIONAL SKILL COURSE<br>SEM – I - Wine Technology | Credits | Lectures/<br>Week |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------|-------------------|
| 24BTVC141                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Paper I Wine Technology Practical                    | 2       | 4                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● To impart the knowledge of Wine and Fermentation</li> <li>● Categorize Wines and the microorganisms based on various growth conditions.</li> <li>● Differentiate between the Processes of development of Different wines.</li> <li>● To Identify, formulate, and solve complex problems related to viticulture by applying principles of Biotechnology</li> </ul>                                                                                                                                                                                                                                                                                                          |                                                      |         |                   |
| <p style="text-align: center;"><b>Topics</b></p> <ol style="list-style-type: none"> <li>1) Wine Technology laboratory instruments: Refractometer, Hydrometer Colorimeter Distillation Unit</li> <li>2) Identification of grape &amp; wine varieties (To study the different types of varieties of grapes suitable for the production of wine)</li> <li>3) Different types of wines and Types of wine glasses</li> <li>4) To study threshold detection of acid taste</li> <li>5) To study threshold detection of sweet taste.</li> <li>6) To study threshold detection of bitter taste.</li> <li>7) Alcohol estimation in wine</li> <li>8) Sensory evaluation of white wine &amp; red wine.</li> <li>9) Effect of the serving temperature on wine</li> <li>10) Interaction of sweet, acid and bitter taste</li> </ol> |                                                      |         |                   |

| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>SKILL ENHANCEMENT COURSE<br/>SEM – I - Microbial Culture Techniques</b> | <b>Credits</b> | <b>Lectures/<br/>Week</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------|---------------------------|
| <b>24BTSC151</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Paper I Microbial Culture Techniques Practical</b>                      | <b>2</b>       | <b>4</b>                  |
| <p><b>Course Outcomes:</b></p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> <li>● Impart the knowledge of growth of microorganisms.</li> <li>● Categorize microorganisms based on various characteristics.</li> <li>● Differentiate between various media used for culturing microorganisms and decide which one is appropriate for the microorganism used in the experiment.</li> </ul>                                                                                                                                                                                                                                                              |                                                                            |                |                           |
| <p style="text-align: center;"><b>Topics</b></p> <ol style="list-style-type: none"> <li>1) Study of Baker's Yeast and Wine's Yeast.</li> <li>2) Identification &amp; isolation of the fungus of Bread</li> <li>3) Identification &amp; isolation of the fungus of Turmeric</li> <li>4) Identification &amp; isolation of the fungus of Rice</li> <li>5) Identification of gram positive and gram negative bacteria by Gram staining technique.</li> <li>6) Aerogravimetric analysis of microorganism.</li> <li>7) To identify the microorganisms present in the Sea water Sample</li> <li>8) Breed's count.</li> <li>9) Measurement of cell mass microscopic count (Direct and indirect enumeration methods).</li> </ol> |                                                                            |                |                           |



## Semester II

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | MAJOR I SEM – II                                                                                                                                                                                                                                                                                                                        | Credits        | Lectures/Week |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|
| 24BTMJ211                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Paper I Fundamentals of Biotechnology-2                                                                                                                                                                                                                                                                                                 | 2              | 2             |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>• The learner will be able to impart skills about Food and Medical Biotechnology</li> <li>• Explain the application of biotechnology in the food industry</li> <li>• Demonstrate the role of vaccines in medical biotechnology.</li> <li>• Describe the concept of genetic engineering and state various components of it.</li> </ul> |                                                                                                                                                                                                                                                                                                                                         |                |               |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Topics                                                                                                                                                                                                                                                                                                                                  | No of Lectures |               |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Medical biotechnology and Immunotechnology</b><br>Introduction to Medical Biotechnology<br>Vaccines<br>Types of vaccines<br>General vaccine production<br>Large scale production of vaccine<br>Trends in Vaccines Research<br>Issues related to vaccine research<br>Organ transplant cloning<br>Stem cells -Sources and applications | 15             |               |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| II | <p><b>Genetic engineering</b><br/> rDNA technology –Definitionanddevelopments<br/> What is genetic engineering?<br/> What is gene cloning?<br/> Strategy for cloning – How to clone a gene?<br/> How to construct rDNA?<br/> Source DNA [insert]<br/> Isolation of DNA from bacterial cell<br/> <b>Enzymes in rDNA –</b><br/> 1. restriction endonuclease;<br/> 2. DNA ligase;<br/> . Enzymes to modify ends of DNA molecules -<br/> Exonuclease,endonuclease reverse<br/> transcriptase; terminal deoxynucleotidyl transferase<br/> <b>Vectors –</b> Role as agents of transfer<br/> Features of plasmid vectors<br/> Plasmid vectors - pBR322<br/> Introducing insert into cloning vector<br/> Host cells – E. coli;<br/> Introducing vector into host –<br/> Prokaryote<br/> Identification of recombinant clones</p> | 15 |
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**Textbooks:**

- Food Microbiology, 5<sup>th</sup> edition, William C. Frazier, Dennis C. Westhoff, N.M. Vanitha, McGraw Hill Education, India
- Fundamentals of Food Biotechnology, 2<sup>nd</sup> edition, Byong H. Lee, Wiley Blackwell
- Prescott's Microbiology, 9<sup>th</sup> edition, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw-Hill, USA

**Additional References:**

- Industrial Microbiology, A. H. Patel
- Biotechnology Fundamentals by Dr. FirdosAlam Khan
- Medical Biotechnology Glick 1st edition

| Course Code                                                                                                                                                                                                                      | MAJOR II SEM – II                               | Credits | Lectures/<br>Week |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------|-------------------|
| 24BTMJ212                                                                                                                                                                                                                        | Paper II Cell Biology Physiology and Immunology | 2       | 2                 |
| <p><b>Course Outcomes:</b><br/> After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> <li>● To impart the knowledge of Physiology and Immunological Techniques</li> </ul> |                                                 |         |                   |



| Unit | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No of Lectures |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| I    | <p><b>Ultrastructure of Prokaryotic and eukaryotic cells and physiology</b></p> <p><b>Ultrastructure of Prokaryotic Cell:</b><br/>           Concept of Cell shape, size, and arrangement<br/>           Bacterial structures external to cell wall - Flagella, Pilli,<br/>           Cell Wall(Gram Positive and Negative);</p> <p><b>Ultrastructure of Eukaryotic Cell:</b><br/>           Cell wall; Plasma membrane, Cytoplasmic Matrix,<br/>           Nucleus –Nuclear Structure, nuclear envelope,<br/>           nucleoplasm, Nucleolus; cytoplasmic structures –<br/>           cytoplasmic inclusions, cytoplasmic organelles -<br/>           Endoplasmic Reticulum; Golgi Apparatus;<br/>           Mitochondria; Chloroplasts; Ribosomes; Lysosome -<br/>           Endocytosis, Phagocytosis, Autophagy; Peroxisomes.<br/>           Microfilaments, Intermediate Filaments, and<br/>           Microtubules<br/>           External Cell Coverings: Cilia And Flagella</p> <p><b>Comparison of Prokaryotic And Eukaryotic Cells</b><br/>           Photosynthesis.<br/>           Light Reactions, Cyclic and Non-Cyclic Photo<br/>           induced Electron Flow,<br/>           Energetics of Photosynthesis,</p> <p><b>Introduction to physiology.</b> Concept of<br/>           Homeostasis</p> <p><b>Respiratory system:</b> Phases of Respiration,<br/>           Principle of gaseous exchange</p> <p><b>Excretion</b> – Organs of excretion. Types of excretory products.</p> | 15             |
| II   | <p><b>Immunology</b><br/> <b>Introduction to Immunology:</b><br/>           Overview of Immune Systems,<br/>           Innate Immunity, Mechanisms of innate immunity,<br/>           Acquired Immunity,<br/>           Local and Herd Immunity,<br/>           Humoral and Cellular Immunity - Factors Influencing<br/>           and<br/>           Mechanisms of each.<br/>           Introduction to Immunotechnology</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15             |

**Textbooks:**

- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by Verma and Agarwal
  - Cell and Molecular Biology by Karp, 6<sup>th</sup> Ed
  - The Cell by Cooper and Hausman, 4<sup>th</sup> Ed
  - 4. Leininger Principles of Biochemistry, 5th Edition- Nelson D. L., and Cox M. M. (2008) W H Freeman and Company
  - 5. A textbook of plant physiology and biochemistry by S K. Verma ( S Chand publications) part 1- physiology- ( photosynthesis)
  - 6. Plant Physiology: Theory and Applications, 2e- S. L. Kochhar and Sukhbir Kaur Gujral , Cambridge University
- Advanced Biotechnology By R C Dube

**Additional References:**

- Microbiology Stanier 5th ed
- Pelczar Ried and Chan

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MAJOR SEM – II – Practicals | Credits | Lectures/<br>Week |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------|-------------------|
| 24BTMJP211                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                             | 2       | 4                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● To impart the knowledge of Physiology and Immunological Techniques.</li> <li>● To learn about different analytical techniques and apply that knowledge to different concepts.</li> <li>● To understand various separation techniques such as Chromatography.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |         |                   |
| <b>Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                             |         |                   |
| <ol style="list-style-type: none"> <li>1. Sterility Checking of Vaccines.</li> <li>2. Isolation and Enumeration of microorganisms- Serial dilution, Surface spread method.</li> <li>3. Isolation and Enumeration of microorganisms- Serial dilution, Pour plate method.</li> <li>4. Problems on Restriction digestion.</li> <li>5. Monochrome staining, Differential Staining, Special and Fungal Staining.</li> <li>6. Study of growth curve of <i>E.coli</i>.</li> <li>7. Isolation techniques: T-streak, polygon method</li> <li>8. Colony Characteristics of Microorganisms.</li> <li>9. Solvent extraction of plant pigments and study the absorption spectra of pigments Study of Hill's reaction.</li> <li>10. Separation of Carotenoids by thin layer chromatography</li> <li>11. Study of human blood count (RBC and WBC) using Haemocytometer</li> <li>12. Study of Antigen antibody interaction by Ouchterlony method</li> </ol> |                             |         |                   |

### Minor Papers

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Minor SEM II – Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Credits           | Lectures/<br>Week |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 24BTMR221                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Paper III Basic Chemistry and Biomolecules-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2                 | 2                 |
| <b>Course Outcome:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● To impart knowledge of Titrimetric and Volumetric Estimations and handling of basic Analytical Techniques like Chromatography and Colorimetry</li> <li>● Identify isomers of molecules.</li> <li>● Explain the types of chemical bonds.</li> <li>● Interpret the results based on the understanding of titration end points.</li> <li>● To impart hands-on skills in preparation of Buffers and Solutions</li> <li>● To impart the knowledge of Classification, Structure and Characterization of Biomolecules</li> <li>● Use the acquired knowledge in preparation of buffers and solutions.</li> <li>● Differentiate between various types of carbohydrates and lipids.</li> <li>● Explain the characteristics and functions of carbohydrates and lipids.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No of<br>Lectures |                   |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Nomenclature and Chemical bonds Titrimetry</b><br>Classification and Systematic Nomenclature of organic compounds.<br><br>Chemical Bonds: Types and transition between the main types of bonding.<br><br>Ionic Bond: Nature of Ionic Bond, factors influencing the formation of Ionic Bond. Structure of NaCl and CsCl.<br>Covalent Bond: Nature of Covalent Bond, Types of covalent bond (Polar and Coordinate covalent bonds).<br>Hydrogen Bond: Theory of Hydrogen Bonding and Types of Hydrogen Bonding<br>Titrimetric Analysis: Titration, Titrant, Titrand, End Point, Equivalence Point, Titration Error, Indicator, Primary and Secondary Standards, Characteristics, and examples.<br>Types of Titrations – Acid –Base, Redox. Precipitation, | 15                |                   |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p><b>Water, Standard solutions and Buffers, Basics of Carbohydrate Chemistry</b></p> <p>Structure, Properties, and functions of water<br/> Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (Numerical expected).<br/> Buffer solutions –Concept of Buffers,<br/> Biological buffers:<br/> Significance of biological buffers.<br/> pH of body fluids like blood and saliva.<br/> Blood buffer systems:<br/> Eg : Carbonate, Acetate and Phosphate buffers.</p> <p>Carbohydrates: Introduction definition and general formula.<br/> Classification of carbohydrates -<br/> Monosaccharides - Two Families of Monosaccharides. Aldo series and keto series; ( Triose - Glyceraldehyde and Dihydroxyacetone, Tetrose- Erythrose and Erythrulose, Pentose- Xylose, Xylulose, Ribose, Ribulose, Hexose- Glucose, Galactose, Mannose, Heptose- sedoheptose and Sedoheptulose structures to be taught )<br/> Concept of Enantiomers, Mutarotation, Anomeric carbon and Epimers of glucose.</p> | 15 |
| <p><b>Textbooks:</b></p> <ul style="list-style-type: none"> <li>● A Textbook of Organic Chemistry, 15<sup>th</sup> edition, Arun Bahl, B S Bahl, S. Chand</li> <li>● Vogel's Textbook of Quantitative Analysis, Fifth Edition</li> <li>● Organic Chemistry, by Solomon and Fryhle</li> <li>● Robert Murray, Daryl G., Peter M., Victor R.; Harper's Illustrated Biochemistry.</li> <li>● Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3<sup>rd</sup> Edition. Books and Allied (P) Ltd.</li> <li>● Lehninger PRINCIPLES OF BIOCHEMISTRY by Nelson and Cox Fifth Edition</li> </ul> <p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>● Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet &amp; Judith Voet, John Wiley and Sons, I. USA</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |    |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Minor SEM II - Paper I-Microbiology-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Credits           | Lectures/<br>Week |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 24BTMR222                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Paper I-Microbiology-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2                 | 2                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● To impart the knowledge of growth of microorganisms.</li> <li>● Categorize microorganisms based on various characteristics.</li> <li>● Experiment with different sterilization techniques.</li> <li>● Differentiate between various staining techniques and decide the appropriate one as per requirement in planned experiments.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No of<br>Lectures |                   |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Introduction to microbiology</b><br><b>Fundamentals, History and Evolution of Microbiology.</b><br>Discovery of Microorganisms, Conflict over spontaneous generation. Role of microorganisms in disease<br><br><b>Classification:</b><br>The place of Microorganisms in the living world<br>Classification whittaker's five kingdom classification<br>Introduction to Bergey's Manual<br>Groups of Microorganisms<br>Applications of microbiology in various fields<br><br><b>Cultivation and Maintenance of microorganisms, Nutritional categories of microorganisms,</b><br>methods of isolation.<br><br><b>Definition and Scope of Industrial Microbiology</b> | 15                |                   |

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| II                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>Sterilization techniques</b></p> <p><b>Microscopy and stains :</b><br/>Sterilization and Disinfection.</p> <p><b>Microscope-</b> Simple and Compound: General principles of optics; various parts and their functions - objectives – numerical aperture, resolving power, depth of focus, working distance, aberrations; oculars; condensers.</p> <p>Dark Field Microscope; Phase Contrast Microscope and Fluorescent Microscope, TEM, SEM</p> <p>Maintenance of Microscopes</p> <p><b>Applications of microscopes</b></p> <p><b>Stains and Staining Solutions</b><br/>Simple Staining, Differential Staining – Gram staining and Acid Fast Staining with specific examples</p> | 15 |
| <p><b>Textbooks:</b></p> <ul style="list-style-type: none"> <li>● Microbiology by Prescott 5th edition</li> <li>● Microbiology by Pelczar, Reid and Chan 5th Edition</li> <li>● Textbook of Microbiology by Ananthanarayan</li> </ul> <p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>● Fundamental Principles of Bacteriology A J Salle 7th</li> <li>● Microbiology by Pelczar, Chan and Krieg, 5th Ed</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Minor Sem II Life Science- | Credits           | Lectures/<br>Week |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------|-------------------|
| 24BTMRP223                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Paper I Life Science-I     | 2                 | 2                 |
| <p><b>Course Outcomes:</b><br/>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> <li>● To impart skills in Techniques in Genetic Analysis and Population Genetics</li> <li>● Explain types of genetic mapping in bacteria.</li> <li>● Describe the fundamentals in genetics based on mendelian principles.</li> <li>● Apply the principles learned in genetics in identifying and demonstrating hereditary genetic traits in one's family. (LO apply and analyse)</li> </ul> |                            |                   |                   |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Topics                     | No of<br>Lectures |                   |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p><b>Microbial genetics and Molecular Biology</b></p> <p><b>Genetic analysis in Bacteria:</b><br/>         Prototrophs, Auxotrophs.</p> <p><b>Genetic Mapping in Bacteria by Conjugation:</b><br/>         Discovery of Conjugation in E.coli. The sex factor F</p> <p><b>Genetic mapping in bacteria by Transformation.</b></p> <p><b>Genetic mapping in Bacteria by Transduction:</b><br/>         Bacteriophages - Lytic and Lysogenic pathway.</p> <p><b>Karyotype and Idiogram</b><br/>         Parameters used in Karyotype preparation- Human Karyotype (Normal) - Male and Female.<br/>         Definition of Mutations-<br/>         Classification of mutations<br/>         Types of Point Mutations,<br/>         Types of Spontaneous and induced mutations<br/>         Mutagenesis and types of Mutagens.<br/>         (Examples of Physical, Chemical and Biological Mutagens)</p> | 15 |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b>Population genetics</b></p> <p><b>Genetic Structure of Populations –</b><br/>         Hardy- Weinberg Law and its Assumptions<br/>         Genetic Variations in Populations,<br/>         Forces responsible for change in gene frequencies in population- Natural Selection.<br/>         Genetic Drift<br/>         migration<br/>         Speciation<br/>         Role of Population Genetics in Conservation Biology<br/>         Genetic Polymorphism</p>                                                                                                                                                                                                                                                                                                                                                                                                                               | 15 |
| <p><b>Textbooks:</b></p> <ul style="list-style-type: none"> <li>● iGenetics – A molecular approach Peter J Russell 3rd edition.</li> <li>● Biochemistry - U Satyanarayana U. Chakrapani, (2013) 4th edition</li> <li>● Principles of Genetics. E J Gardner, M J Simmons &amp; D Peter Snustad. 8th edition</li> <li>● A Textbook of Biotechnology By R.C. Dube</li> </ul> <p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>● Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications)</li> <li>● Genetics, (2006) Strickberger MW - (Prentice Hall, India)</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |





| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | VOCATIONAL SKILL COURSE<br>SEM – II - Analytical Instrumentation Techniques | Credits | Lectures/<br>Week |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------|-------------------|
| 24BTVC241                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Paper I Analytical Instrumentation Techniques<br>Practical                  | 2       | 4                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● To gain knowledge of the many categories of analytical instruments.</li> <li>● Demonstrate an understanding of the fundamental theoretical concepts and underlying techniques of microscopy, spectroscopy analysis and chromatography.</li> <li>● Comply with procedures and prepare samples for chromatographic, electrophoretic, spectroscopic, and microscopy examination.</li> <li>● Use a variety of analytical instruments while being closely supervised.</li> <li>● Analyse analytical data to provide quantitative outcomes.</li> </ul> |                                                                             |         |                   |
| 1) Types of microscopy<br>2) Different types of staining: Direct staining and Indirect staining<br>3) Thin layer chromatography.<br>4) 2D chromatography<br>5) To Study the Principle and working of colorimeter<br>6) To Study the principle and working of Spectrophotometer.<br>7) Electrophoresis: Introduction<br>8) Agarose Gel electrophorens.<br>9) PAGE.                                                                                                                                                                                                                                                                                                                          |                                                                             |         |                   |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | SKILL ENHANCEMENT COURSE<br>SEM – II                                                           | Credits | Lectures/<br>Week |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------|-------------------|
| 24BTSC251                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Paper I Crop Improvement Strategies,<br/>omposting and Solid waste management Practical</b> | 2       | 4                 |
| <b>Course Outcomes:</b><br>After successful completion of this course, students would be able to <ul style="list-style-type: none"> <li>● Understand basic concepts of Plant Breeding.</li> <li>● To acquire knowledge about High yielding hybrid crops.</li> <li>● To discuss different solid waste management techniques</li> <li>● To understand different Composting methods.</li> </ul>                                                                                                                                                                                                                                                                                                  |                                                                                                |         |                   |
| <p style="text-align: center;"><b>Topics</b></p> <ol style="list-style-type: none"> <li>1. Study of pollen grains &amp; types of pollination techniques.</li> <li>2. High yielding hybrid Crop varieties :Wheat, Rice, Sugarne, sorghum, millets, Roses</li> <li>3. Types of Rubby &amp; Kharip crops</li> <li>4. Different Abiotic and Biotic stresses</li> <li>5. Different vegetative propagation methods</li> <li>6. Study of plant pathogens.</li> <li>7. Study Composting: Different types of composting</li> <li>8. Study of Composting process.</li> <li>9. Study of Organic farming</li> <li>10. Types of Rubby &amp; Kharip crops Different Abiotic and Biotic stresses.</li> </ol> |                                                                                                |         |                   |

## **Evaluation Scheme for First Year (UG) under NEP (2 credits)**

### **I. Internal Evaluation for Theory Courses – 20 Marks**

**1) Continuous Internal Assessment(CIA) Assignment** - Tutorial/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

**2) Continuous Internal Assessment(CIA)** ONLINE Unit Test – 10 marks

### **II. External Examination for Theory Courses – 30 Marks**

Duration: 1 Hour

Theory question paper pattern: All questions are compulsory.

| Question | Based on | Marks |
|----------|----------|-------|
| Q.1      | Unit I   | 15    |
| Q.2      | Unit II  | 15    |

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weight age of the topic.

### **III. Practical Examination**

- Each core subject carries 50 Marks.( 30 marks external+20 marks internal)
- Duration: 2 Hours for each practical course.
- Certified Journal is compulsory for appearing at the time of Practical Exam

**NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.**