

**Level:- 5.5 (Third Year) Sem:-V**

***Progressive Education Society's***  
**Modern College of Arts, Science and Commerce (Autonomous),**  
**Shivajinagar, Pune - 5**  
**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5101**

**Course Name: Microbial Biotechnology (T)**

**Teaching Scheme: TH: 2 Hours / Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite:** The students should have the basic knowledge of microbiology and biotechnology.

**Course Objectives:**

- To study in detail the use of microorganisms in technological advances.
- To learn the different techniques used in industries using biological systems.

**After successful completion of this course students will able to:**

| <b>CO No</b> | <b>Course Outcomes (COs)</b>                                                                | <b>Blooms<br/>Cognitive level</b> |
|--------------|---------------------------------------------------------------------------------------------|-----------------------------------|
| <b>CO 1</b>  | Understand the role of microorganisms in nature                                             | 1                                 |
| <b>CO 2</b>  | Infer the use growth curve in industries                                                    | 2                                 |
| <b>CO 3</b>  | Identify and describe the characteristics of important food borne pathogens                 | 3                                 |
| <b>CO 4</b>  | Analyze various methods for their isolation, detection and identification of microorganisms | 4                                 |
| <b>CO 5</b>  | Select microorganisms for various fermentation processes                                    | 5                                 |
| <b>CO 6</b>  | Plan various experiments based on the lessons studied.                                      | 6                                 |

**Course Contents**

| Unit   | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 30 lectures |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit 1 | Microbial Biotechnology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2 lectures  |
|        | <ul style="list-style-type: none"> <li>• Introduction to microbial biotechnology- Evolution of use of microorganisms in fermentation, its scope</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |
| Unit 2 | Introduction to fermentation processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 8 lectures  |
|        | <ul style="list-style-type: none"> <li>• History of fermentation</li> <li>• Instruments used in fermentation process- Fermenter- Design of fermenter, Types of fermenters - Bubble column, Bubble Cap, Air Lift (internal and external loop) • Packed Bed reactor, Fluidized bed reactor, Animal and Plant cell Bioreactors</li> <li>• Factors affecting the growth of microorganisms (Classification of microorganisms on the basis of their environmental requirements) such as : pH, temperature, oxygen, salt, sugar, moisture</li> <li>• Molecular adaptations to extreme environments.</li> </ul> |             |
| Unit 3 | Microbial growth kinetics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4 lectures  |
|        | <ul style="list-style-type: none"> <li>• Batch (Monod's equation), fed-batch, continuous cultures</li> <li>• Yield coefficients: Definition and concept- <math>Y_{x/s}</math>, <math>Y_{p/s}</math>, <math>Y_{p/x}</math>, <math>Y_{ATP}</math>, Respiratory quotient.</li> <li>• Growth in relation to product formation (Growth-linked &amp; Non-growth linked)- Vitamins, Antibiotics, Enzymes</li> </ul>                                                                                                                                                                                            |             |
| Unit 4 | Microbial production of enzymes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3 lectures  |
|        | <ul style="list-style-type: none"> <li>• Types of enzymes produced by the microorganisms and their uses.</li> <li>• Immobilization of enzymes-Methods, Properties, Applications, Advantages and Disadvantages</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                |             |
| Unit 5 | Novel pathways in Microorganisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3 lectures  |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|               | <ul style="list-style-type: none"> <li>• Glyoxylate cycle</li> <li>• PHB production</li> <li>• Poly ketides-antibiotics</li> <li>• Propionate fermentation using acrylate pathway and succinate-propionate pathway</li> <li>• Mixed acid and butanediol fermentation</li> </ul>                                                                                                                                                                        |                   |
| <b>Unit 6</b> | <b>Food Microbiology</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>5 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Food as a substrate (Intrinsic and extrinsic factors)</li> <li>• Microbiological spoilages of foods and sources of microorganisms.</li> <li>• Food Preservation: General principles and methods of food preservation, Use of Chemicals (Added and Developed Preservatives) Canning, Radiations, Low and High Temperature</li> <li>• Concept of HACCP (Hazard Analysis and Critical Control Points)</li> </ul> |                   |
| <b>Unit 7</b> | <b>Applications of Microorganisms</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>5 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Geo-microbiology-Ore leaching (methods and examples), Microorganisms in extraterrestrial life studies</li> <li>• Biofertilizers and Biopesticides and Microbial plant growth Promoters( gibberellins and IAA)</li> <li>• GMOs-Norms and applications</li> <li>• Microbial Polysaccharide production: Xanthan, Dextran, Alginate, Scleroglucan, Gellan, Pullulan, Curdlan</li> </ul>                           |                   |

## References:

1. The Physiology and Biochemistry of Prokaryotes (2<sup>nd</sup> Ed.), David White (2003).Oxford university Press.
2. Principles of fermentation technology, P. F. Stanbury, A. Whitaker, s. j. hall, 2<sup>ND</sup> EDITION, Butterworth Heinemann Publication, Burlington.
3. Butterworth Heinemann, Peppler, H. L. Microbial Technology, Vol. I and II, 2nd Edition (1979), Academic Press.
4. Patel, A. H., Industrial Microbiology, 1st edition, (2007), Macmillan India Ltd.
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6. Industrial Microbiology, A. H. Patel, 2<sup>nd</sup> Edition, Trinity Press.
- 7.A textbook of Biotechnology, R. C. Dubey, S. Chand and Company.
8. Textbook of Microbiology, Anathnarayan and Panikar, 10<sup>th</sup> Edition,
9. Modern Food Microbiology, James Jay,6<sup>th</sup> Edition, Aspen Publication.
10. Industrial Microbiology, L.E.J.R. Casida, 2<sup>nd</sup> edition, 2019.



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**Third Year of B.Sc. Biotechnology**  
**(NEP 2020 uunder 2024 Pattern) Semester V**

**Course Code: 24ScBioU5102**

**Course Name: Protein Biology**

**Teaching Scheme: TH: 2 Hours/Week**

**Credit: 2C(2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

The course requires that the students are well versed with properties and characters of proteins that they have learned in their earlier syllabus.

**Course Objectives:**

As proteins are the molecules that enable most of life's tasks, an understanding of proteins and their properties is highly valuable for all areas of biomolecular research.

The selective pressures of evolution largely occur at the level of protein structure and dynamics; therefore, this course focuses on the relationship between the structure/function of proteins.

**Course Outcomes:**

On completion of the course, student will be able to–

| <b>CO No</b> | <b>Course Outcomes (COs)</b>                      | <b>Blooms Cognitive level</b> |
|--------------|---------------------------------------------------|-------------------------------|
| <b>CO 1</b>  | Recall basic concepts related to protein.         | <b>1</b>                      |
| <b>CO 2</b>  | Illustrate structural organization of protein.    | <b>2</b>                      |
| <b>CO 3</b>  | Identify protein folding mechanism.               | <b>3</b>                      |
| <b>CO 4</b>  | Analyze amino acid metabolism.                    | <b>4</b>                      |
| <b>CO 5</b>  | Assess applications of protein in various fields. | <b>5</b>                      |
| <b>CO 6</b>  | Design experiments in protein biology.            | <b>6</b>                      |

## Course Contents

| Unit   | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 30 Lectures |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit 1 | Introduction to proteins                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 08 lectures |
|        | <ul style="list-style-type: none"><li>• Introduction and functions of protein</li><li>• Classification of proteins with examples: Simple, complex, Fibrous, Globular.</li><li>• Overview &amp; properties of amino acids</li></ul>                                                                                                                                                                                                                                                                                                     |             |
| Unit 2 | Protein Structure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10 lectures |
|        | <ul style="list-style-type: none"><li>• Primary structure of proteins: Peptide bond &amp; its characteristics.</li><li>• Secondary structure: Alpha helix, Beta sheets, Beta turns, Ramachandran plot, Super secondary structures</li><li>• Tertiary structure: Keratin structure,</li><li>• Non covalent interactions that stabilize protein structure.</li><li>• Quaternary structure: Hemoglobin</li><li>• Folding &amp; Misfolding of protein (Chaperone)</li><li>• Renaturation and Denaturation (Molten Globule Model)</li></ul> |             |
| Unit 3 | Protein Metabolism                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 7 lectures  |
|        | <ul style="list-style-type: none"><li>• Degradation –Amino acids degradation, transamination and Urea Cycle.</li><li>• Amino acid synthesis</li><li>• Protein turnover (Lysosomal and Ubiquitin Mediated Pathway)</li></ul>                                                                                                                                                                                                                                                                                                            |             |
| Unit 4 | Applications of protein                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5 Lectures  |
|        | <ul style="list-style-type: none"><li>• Proteins in Biological system: Lipoproteins, Immunoglobulins, Hormones, Membrane protein.</li><li>• Proteins in industry</li><li>• Therapeutic Vaccines, Industrial enzymes (Protease/Amylase)</li></ul>                                                                                                                                                                                                                                                                                       |             |

## References:

1. Lehninger Principles of Biochemistry; David L. Nelson, Michael M. Cox; 7<sup>th</sup> edition; New York: W.H. Freeman; [2017].
2. Biochemistry; Reginald H, Garrett M, Grisham; 7th edition; Belmont, California: Brooks/Cole; [2013].
3. Principles of Biochemistry; Moran A; 5th edition; Pearson Boston; [2012].
4. Harper's Illustrated Biochemistry; Robert Murray, Darryl Granner, Peter Mayes, Victor Rodwell; 26<sup>th</sup> edition; McGraw Hill Professional; [2003].
5. Biochemistry; Rex Montgomery, Thomas W. C, Arthur AS, Barry H. G; 5<sup>th</sup> edition; St. Louis: Mosby; [1990].
6. Principles of biochemistry; Donald Voet, Judith Voet, Charlotte Pratt; 5<sup>th</sup> edition; Hoboken, NJ: Wiley; [2008].
7. Outlines of Biochemistry; E. Conn, P. Stumpf; 4<sup>th</sup> edition; New York, Wiley; [1976].
8. Concepts in biochemistry; Boyer RF; Pacific Grove, Calif: Brooks/Cole; [1999]

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**Third Year of B.Sc. (Biotechnology**

**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5103 Course Name: Environment, Ecology and Biodiversity**

**Teaching Scheme: TH: 2 Hours /Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

Knowledge of environment and basics of ecosystem Ecology

Knowledge of plant & animal ecology in India.

**Course Objectives:**

To understand Ecology, environment and its measurements

To Study Biodiversity and Ecosystems.

To understand bioremediation and hazard waste management.

To study population diversity and conservation of biodiversity.

**Course Outcomes:**

| <b>CO No</b> | <b>Course Outcomes (COs)</b>                                                         | <b>Blooms<br/>Cognitive level</b> |
|--------------|--------------------------------------------------------------------------------------|-----------------------------------|
| <b>CO 1</b>  | To become aware about environment and preventive measures of pollution.              | <b>1</b>                          |
| <b>CO 2</b>  | Develop knowledge of different types of ecosystems and factors affecting ecosystems. | <b>2</b>                          |
| <b>CO 3</b>  | To learn ecological succession and energy flow.                                      | <b>3</b>                          |
| <b>CO 4</b>  | To analyze current global environment issues                                         | <b>4</b>                          |
| <b>CO 5</b>  | To understand research in Biodiversity and Environment.                              | <b>5</b>                          |
| <b>CO 6</b>  | Field study to understand Biodiversity and Hot Spots in India.                       | <b>6</b>                          |

## Course Contents

|               | <b>Ecology</b>                                                                                                                                                                                                                                                                                     |                    |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Unit</b>   | <b>Topic</b>                                                                                                                                                                                                                                                                                       | <b>15 Lectures</b> |
| <b>Unit 1</b> | <b>Understanding Environment and Ecology</b>                                                                                                                                                                                                                                                       | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Introduction to Environmental science and Ecology</li> <li>• Environmental Components- Atmosphere, Hydrosphere, Lithosphere and Biosphere</li> </ul>                                                                                                      |                    |
| <b>Unit 2</b> | <b>Ecosystem : Principles and its concepts-</b>                                                                                                                                                                                                                                                    | <b>3 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Introduction. Definition, Characteristics</li> <li>• Components of ecosystem</li> <li>• Types of ecosystem</li> <li>• Aquatic and terrestrial Ecosystems</li> <li>• Homeostasis</li> <li>• Biotic community</li> <li>• Ecotone and edge effect</li> </ul> |                    |
| <b>Unit 3</b> | <b>Ecological succession</b>                                                                                                                                                                                                                                                                       | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Introduction, Definition ,Types of succession examples of succession</li> <li>• General process of succession</li> <li>• Concept and types of climax</li> </ul>                                                                                           |                    |
| <b>Unit 4</b> | <b>Energy Flow</b>                                                                                                                                                                                                                                                                                 | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Food chain and food web</li> <li>• Trophic Levels</li> <li>• Energy efficiency and Energy Budget</li> <li>• Nutrient cycles (Nitrogen, Phosphorus, and Carbon)</li> </ul>                                                                                 |                    |
| <b>Unit 5</b> | <b>Bioremediation</b>                                                                                                                                                                                                                                                                              | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of Bioremediation</li> <li>• Importance of bioremediation</li> <li>• Microbial Biodegradation (Plastic, Pesticides/Insecticides and Herbicides, Hydrocarbons)</li> </ul>                                                    |                    |
| <b>Unit 6</b> | <b>Hazards and Waste Management</b>                                                                                                                                                                                                                                                                | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Hazards in environment</li> <li>• Biomedical waste management</li> <li>• Integrated waste management</li> </ul>                                                                                                                                           |                    |
| <b>Unit 7</b> | <b>Current global environmental issues</b>                                                                                                                                                                                                                                                         | <b>2 lectures</b>  |

|               |                                                                                                                                                                                                                                                               |                    |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|               | <ul style="list-style-type: none"> <li>• Acid rains causes and effects</li> <li>• Greenhouse Gases, Green House Effect and Global warming</li> <li>• Ozone depletion</li> <li>• Global Climate Change</li> <li>• Impact of global warming in India</li> </ul> |                    |
|               | <b>Biodiversity</b>                                                                                                                                                                                                                                           | <b>15 Lectures</b> |
| <b>Unit 1</b> | <b>Understanding of Biodiversity</b>                                                                                                                                                                                                                          | <b>4 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Concept of biodiversity ,</li> <li>• Definition , Taxonomic, ecological and genetic perspectives of biodiversity,</li> <li>• Change in Biodiversity over time and space,</li> </ul>                                  |                    |
| <b>Unit 2</b> | <b>Ecosystem diversity</b>                                                                                                                                                                                                                                    | <b>4 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Species diversity</li> <li>• Genetic diversity</li> <li>• Ecosystem Community Diversity.</li> </ul>                                                                                                                  |                    |
| <b>Unit 3</b> | <b>Biodiversity in Ecosystem</b>                                                                                                                                                                                                                              | <b>3 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Biodiversity in India : Habitats, Niche, Hot spots of biodiversity</li> <li>• Biomes of the world: Animals, plants and micro organism.</li> </ul>                                                                    |                    |
| <b>Unit 4</b> | <b>Population diversity</b>                                                                                                                                                                                                                                   | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Population density, abundance and richness</li> <li>• Population Structure and interactions</li> </ul>                                                                                                               |                    |
| <b>Unit 5</b> | <b>Conservation of Biodiversity</b>                                                                                                                                                                                                                           | <b>2 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>• Need for conservation of biodiversity</li> <li>• Strategies for conservation ,</li> <li>• Methods for conservation –<i>Ex situ</i> and <i>In situ</i></li> </ul>                                                     |                    |

### References:

1. Ecology and environment (2005) Sharma PD Rastogi Publication, New Delhi.
2. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata.
3. Ecology science and practice (2001) Faurie et al Oxford & IBH Publ. Co. Pvg. Ltd, New Delhi.
4. Ecology: Principles and Applications (1998) J. L. Chapman, M. J. Reiss Cambridge University Press, Cambridge
5. Environmental Biology (2000) Varma & Agarwal S. Chand Limited, New Delhi.
6. Environmental biology and toxicology (2011) Sharma PD Rajpal And Sons Publishing, Delhi.
7. Environmental biotechnology (2010) Rana Rastogi Publications, New Delhi.
8. Environmental Science (2011) Santra S.C. New Central Book Agency, Kolkata.

9. Fundamentals of Ecology (2005) Eugene Pleasants Odum, Gary W. Barrett Brooks and Coel, USA
10. Fundamentals of Ecology (2009) Dash 3<sup>rd</sup> edition, Tata McGraw-Hill Education, New Delhi

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Third Year of B.Sc. (Biotechnology)  
(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5104**  
**Teaching Scheme: TH: 2 Hours/Week**  
**Examination Scheme: CIA: 20 Marks**

**Course Name: Bioinformatics**  
**Credit: 2C (2T)**  
**End-Sem: 30 Marks**

**Prerequisite Courses:**

Basic knowledge of Biology (SSC grade and HSC grade) is required to understand the concepts of molecular biology and rDNA technology

**Course Objectives:**

- ☐ To Study: history, tools , methods and applications of bioinformatics
- ☐ To learn how to retrieve the information available in biological databases.

**After successful completion of this course students will be able to:**

| CO No. | Course Outcomes (COs)                                                                                                   | Bloom's cognitive taxonomy level |
|--------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| CO 1   | Define the historical perspective of Bioinformatics and relation to Molecular Biology                                   | 1                                |
| CO 2   | Outline the basic concept of molecular biology tools and techniques and data types and source of population and sample. | 2                                |
| CO 3   | Identify the various biological database                                                                                | 3                                |
| CO 4   | List of flat file format of various data for storage and retrieval                                                      | 4                                |
| CO 5   | Importance of sequence alignment methods and tools                                                                      | 5                                |
| CO 6   | Design and application of genomics, transcriptomic and proteomics                                                       | 6                                |

**Course Contents**

| Unit   | Topic                                                                                                                                                                                                                                                                                                                                                                                                         | 30 Lectures       |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Unit 1 | <b>Introduction to bioinformatics and data generation</b>                                                                                                                                                                                                                                                                                                                                                     | <b>2 lecture</b>  |
|        | <ul style="list-style-type: none"><li>History of Bioinformatics</li><li>What is bioinformatics and its relation with molecular biology</li></ul>                                                                                                                                                                                                                                                              |                   |
| Unit 2 | <b>Basic concepts</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>5 lectures</b> |
|        | <ul style="list-style-type: none"><li>Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray)</li><li>Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources.</li></ul> |                   |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| <b>Unit 3</b> | <b>General Introduction of Biological Databases</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>7 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Nucleic acid databases (NCBI, DDBJ, and EMBL).</li> <li>• Protein databases (Primary, Composite, and Secondary).</li> <li>• Specialized Genome databases: (SGD, TIGR, and ACeDB).</li> <li>• Structure databases (CATH, SCOP, and PDBsum)</li> <li>• Databases (GENBANK, Pubmed, PDB )</li> </ul>                                                                                                                                                                             |                   |
| <b>Unit 4</b> | <b>Data storage and retrieval</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>6 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Flat files, relational, object oriented databases and controlled vocabularies.</li> <li>• File Format (Genbank, DDBJ, FASTA, PDB, SwissProt).</li> <li>• Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.</li> <li>• The challenges of data exchange and integration.</li> <li>• Ontologies, interchange languages and standardization efforts.</li> <li>• General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFE SCIENCE.</li> </ul> |                   |
| <b>Unit 5</b> | <b>Sequence Alignments and Visualization</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>5 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Introduction to Sequences, alignments and Dynamic Programming;</li> <li>• Local alignment and Global alignment (algorithm and example)</li> <li>• Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm)</li> <li>• Molecular docking</li> <li>• Protein modeling</li> </ul>                                                                                                                                                    |                   |
| <b>Unit 6</b> | <b>Introduction to “ Omics”</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>2 lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Genomics, proteomics and transcriptomics</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |

## References:

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.
6. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
7. Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.

8. Durbin R., Eddy S., Krogh A. and Mithchison G. 2007 Biological Sequence Analysis, Cambridge University Press.

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**Third Year of B.Sc. Biotechnology**

**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5105 Course Name: Lab Course on 24ScBIOU5101 & 24ScBioU5102**

**Teaching Scheme: P: 4hrs./week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite:** Basic concepts of immunology and basic knowledge of properties of biomolecules

**Course Objectives:**

To understand basic isolation, precipitation, purification of simple proteins

**Course contents :**

|                    | <b>Practicals in Microbial Biotechnology</b>                                                                                   |                       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Practical</b>   | <b>Topic</b>                                                                                                                   | <b>Practicals (9)</b> |
| <b>Practical 1</b> | <b>Study of Growth curve</b>                                                                                                   | <b>1</b>              |
|                    | Growth Curve using semi-log paper and Generation time of Bacteria/Yeast using turbidometry                                     |                       |
| <b>Practical 2</b> | <b>Effect of Environmental factors</b>                                                                                         | <b>1</b>              |
|                    | Effect of Environmental factors on growth of bacteria (pH, Temperature, salt and Sugar)                                        |                       |
| <b>Practical 3</b> | <b>Immobilization</b>                                                                                                          | <b>1</b>              |
|                    | Immobilization of whole yeast cells/ enzyme by suitable method and determination of stability of immobilized enzyme.           |                       |
| <b>Practical 4</b> | <b>Grading of raw milk</b>                                                                                                     | <b>1</b>              |
|                    | Grading of raw milk (Dye reduction test, DMC), Determination of efficiency of Pasteurization by quantitative phosphatase test. |                       |
| <b>Practical 5</b> | <b>Assessment of potability of water</b>                                                                                       | <b>2</b>              |
|                    | a.Presumptive test<br>b.Confirmed test<br>c.Completed test.                                                                    |                       |

|                    |                                                                                                |          |
|--------------------|------------------------------------------------------------------------------------------------|----------|
|                    | d. Eijkman's test<br>e. IMViC tests                                                            |          |
| <b>Practical 6</b> | <b>Isolation and identification (up to Genus level)</b>                                        | <b>2</b> |
|                    | Isolation and identification (Genus level) of spoilage causing microorganism from spoiled food |          |
| <b>Practical 7</b> | <b>Industrial visit</b>                                                                        | <b>1</b> |

| <b>Practicals in Protein Biology</b> |                                                                                                                                          |                          |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Practical</b>                     | <b>Topic</b>                                                                                                                             | <b>Total Practical 6</b> |
| <b>Practical 1</b>                   | <b>Isolation</b>                                                                                                                         | <b>1 Practical</b>       |
|                                      | • Isolation of protein and its quality by Biuret method                                                                                  |                          |
| <b>Practical 2</b>                   | <b>Precipitation</b>                                                                                                                     | <b>1 Practical</b>       |
|                                      | • Ammonium sulphate precipitation of crude extract and estimation of its protein content                                                 |                          |
| <b>Practical 3</b>                   | <b>Purification</b>                                                                                                                      | <b>1 Practical</b>       |
|                                      | • Purification of protein by dialysis& its estimation                                                                                    |                          |
| <b>Practical 4</b>                   | <b>Separation</b>                                                                                                                        | <b>3 Practical</b>       |
|                                      | • Separations of amino acids by paper chromatography<br>• Separation of protein by ion-exchange chromatography<br>• SDS PAGE of proteins |                          |

### References:

1. Introduction to Practical Biochemistry By: David T. Plummer.
2. Lab manual in Biochemistry, Immunology, Biotechnology By: Dr. A. Nigam, Dr. A. Ayyagari.
3. Harper's Biochemistry By: Robert K. Myrray.
4. Biochemical methods By: S. Sadasivam, A. Manickam.

5. Practical Manual in Biochemistry & Clinical Biochemistry By: V. Temple, R. Rowe, Willie, Grant
6. Practical Biochemistry By: Geeta Damodaran
7. Lab Manual in Biochemistry, Immunology and Biotechnology (2007). Arti Nigam, and Archana Ayyagari.
8. Handbook of practical and clinical Immunology (Vol. I and II), Second Edition (2017). Talwar and Gupta.
9. Patel, A. H., Industrial Microbiology, 2nd edition, (2016), Laxmi Publications, New Delhi.
10. Industrial Microbiology, A. H. Patel, 2<sup>nd</sup> Edition, Trinity Press.
11. A textbook of Biotechnology, R. C. Dubey, S. Chand and Company.
12. Textbook of Microbiology, Anathnarayan and Panikar, 10<sup>th</sup> Edition,

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**Third Year of B.Sc.(Biotechnology)**

**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5106 Course Name: Lab course on 24ScBioU5103 &24ScBioU5104**

**Teaching Scheme: 4 Hours / Week**

**Credit: 2C (2P)**

Examination Scheme: CIA: 20 Marks

End-Sem: 30

**Prerequisite Courses:**

- Knowledge Environmental Awareness
- The course requires that the students should know basic properties and characters of biomolecules.
- Basic of Zoology and Botany from 11<sup>th</sup> and 12<sup>th</sup> and F.Y. Biotechnology.
- Basics of Molecular Biology and Biotechnology

**Course Objectives:**

- To Study the Biodiversity aspects of diversity plants and Insects.
- To learn Changes diversity and how we conserve diversity in nature.
- To understand the reason n preventative action control pollution
- To understand the Importance of tree plantation
- To Study: history, tools , methods and applications of bioinformatics
- To learn how to retrieve the information available in biological databases.

|                    | <b>Practical in Ecology</b>                                                                                                                                                                                                                                                       |                          |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Practical</b>   | <b>Topic</b>                                                                                                                                                                                                                                                                      | <b>Total practical 5</b> |
| <b>Practical 1</b> | <b>Community sampling-By Quadrature method</b>                                                                                                                                                                                                                                    | <b>1 Practical</b>       |
|                    | 6. Community sampling-By Quadrature method for plants: Percentage of frequency, density, abundance, frequency class diagram and comparison with Raunkiaers frequency chart, Simpson's index of dominance                                                                          |                          |
| <b>Practical 2</b> | <b>Study of polluted and unpolluted soil</b>                                                                                                                                                                                                                                      | <b>2 Practical</b>       |
|                    | <ul style="list-style-type: none"><li>• Estimation of Physical properties of polluted and unpolluted soil by Colour and Texture, Water holding capacity</li><li>○ Estimation of Chemical properties of polluted and unpolluted soil: pH and Alkalinity, Organic content</li></ul> |                          |
| <b>Practical 3</b> | <b>Studying pollution indicator plants</b>                                                                                                                                                                                                                                        | <b>1 Practical</b>       |
|                    | <ul style="list-style-type: none"><li>• Studying pollution indicator plants in terms of morphology and anatomy (any 5-7 plants)</li></ul>                                                                                                                                         |                          |
| <b>Practical 4</b> | <b>Genotoxicity</b>                                                                                                                                                                                                                                                               | <b>1 Practical</b>       |

|                                  |                                                                                                                                                                                                                                                                                                               |                          |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|                                  | <ul style="list-style-type: none"> <li>Genotoxicity and Cytotoxicity assay to estimate water contamination (Polluted and Non Polluted )</li> </ul>                                                                                                                                                            |                          |
| <b>Practical in Biodiversity</b> |                                                                                                                                                                                                                                                                                                               |                          |
| <b>Practical</b>                 | <b>Title</b>                                                                                                                                                                                                                                                                                                  | <b>Total Practical 2</b> |
| <b>Practical 1</b>               | <b>Point count method of biodiversity</b>                                                                                                                                                                                                                                                                     | <b>1 Practical</b>       |
|                                  | <ul style="list-style-type: none"> <li>Point count for bird diversity</li> </ul>                                                                                                                                                                                                                              |                          |
| <b>Practical 2</b>               | <b>Practicals in Field studies for analysis of biotic &amp; abiotic factors</b>                                                                                                                                                                                                                               | <b>1 Practical</b>       |
|                                  | <ul style="list-style-type: none"> <li>Field visit to Forest ecosystem / National Botanical Garden/National Zoological Park/ Biodiversity Park/Visit any Local Garden in Pune / Bird Sanctuaries</li> <li>Report on Comparative study between any two fields ( e.g. Forest &amp; Botanical garden)</li> </ul> |                          |

|                                     |                                                                                                                                                                 |                          |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Practical in Bio-informatics</b> |                                                                                                                                                                 |                          |
| <b>Practical</b>                    | <b>Title</b>                                                                                                                                                    | <b>Total practical 8</b> |
| <b>Practical 1</b>                  | <b>Introduction to biological databases and retrieving the information</b>                                                                                      | <b>• Practical</b>       |
|                                     | <ul style="list-style-type: none"> <li>NCBI, EMBL , DDBJ, Protein database – Uniprot database</li> </ul>                                                        |                          |
| <b>Practical 2</b>                  | <b>Literature Database- (PubMed)</b>                                                                                                                            | <b>2 Practical</b>       |
|                                     | <ul style="list-style-type: none"> <li>Structure databases – PDB, SCOP, CATH</li> </ul>                                                                         |                          |
| <b>Practical 3</b>                  | <b>Study of File Format</b>                                                                                                                                     | <b>2 Practical</b>       |
|                                     | <ul style="list-style-type: none"> <li>Genbank, DDBJ, FASTA, PDB, SwissProt</li> </ul>                                                                          |                          |
| <b>Practical 4</b>                  | <b>Introduction to metadata and searching of information</b>                                                                                                    | <b>1 Practical</b>       |
|                                     | <ul style="list-style-type: none"> <li>Boolean operators (AND, OR , NOT )</li> </ul>                                                                            |                          |
| <b>Practical 5</b>                  | <b>Introduction of sequence alignment</b>                                                                                                                       | <b>2 Practical</b>       |
|                                     | <ul style="list-style-type: none"> <li>Use of BLAST and FASTA tools for pairwise sequence alignment.</li> <li>Multiple Sequence Analysis , Clustal W</li> </ul> |                          |

### References:

1. Ecology and environment (2005) Sharma PD Rastogi Publication, New Delhi.
2. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata
3. Ecology science and practice (2001) Faurie et al Oxford & IBH Publ. Co. Pvt. Ltd
4. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor. 2.  
Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.

5. Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MIT Press.
6. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
7. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press. 6. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics. 7. Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.
8. Durbin R., Eddy S., Krogh A. and Mithchison G. 2007 Biological Sequence Analysis, Cambridge University Press.

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5201**

**Course Name: Nanotechnology**

**Teaching Scheme: TH: 2 Hours / Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

12<sup>th</sup> with basic understanding of chemistry and physics

**Course Objectives:**

To Study the process of generation of nanoparticles

To learn the characterization of nanoparticles

**Course Outcomes:**

On completion of the course, student will be able to–

| CO No | Course Outcomes (COs)                                       | Blooms Cognitive level |
|-------|-------------------------------------------------------------|------------------------|
| CO 1  | Find basic concepts of nanoscience and nanotechnology.      | 1                      |
| CO 2  | Classify nanomaterials.                                     | 2                      |
| CO 3  | Develop nanoparticles using several methods.                | 3                      |
| CO 4  | Analyze nanoparticles based on their characteristics.       | 4                      |
| CO 5  | Determine applications of nanotechnology in various fields. | 5                      |
| CO 6  | Discuss impacts and issues associated with nanotechnology.  | 6                      |

**Course Contents**

| Units  | Topic                                                                                                                                                                                                                                                                     | 30 Lectures |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit 1 | Nano scale Science and Technology                                                                                                                                                                                                                                         | 6 Lectures  |
|        | <ul style="list-style-type: none"><li>The nanoscale: Science and Technology.</li><li>Classification of nanostructured materials</li><li>Length scales involved and its effects on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.</li></ul> |             |
| Unit 2 | Preparation methods of Nanoparticles                                                                                                                                                                                                                                      | 6 Lectures  |
|        | <ul style="list-style-type: none"><li>Bottom-up and Top-down approach: Precipitation, Mechanical Milling.</li><li>Biological synthesis by bacteria, fungi, plants</li></ul>                                                                                               |             |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|               | <ul style="list-style-type: none"> <li>• Advantage and limitations of biological synthesis</li> </ul>                                                                                                                                                                                                                                                                                                              |                   |
| <b>Unit 3</b> | <b>Characterization techniques</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• X-ray diffraction technique,</li> <li>• Scanning Electron Microscopy,</li> <li>• Transmission Electron Microscopy</li> <li>• Confocal microscopy</li> </ul>                                                                                                                                                                                                               |                   |
| <b>Unit 4</b> | <b>Applications of Nanotechnology</b>                                                                                                                                                                                                                                                                                                                                                                              | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• <b>Environment applications:</b> Nano-remediation, Nanopaints, Nanofilters, Nanocatalysts for degradation of pollutants</li> <li>• <b>Medical applications:</b> Nanomedicines, Nanoparticles in Drug delivery, Cancer treatment, Nephrology and Tissue Engineering,</li> <li>• <b>Agricultural applications:</b> Nanofertilizers, Nanopesticides, Nanopigments</li> </ul> |                   |
| <b>Unit 5</b> | <b>Impact of nanotechnology</b>                                                                                                                                                                                                                                                                                                                                                                                    | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Positive and Negative Impact of Nanotechnology</li> <li>• Health and environment Risks</li> <li>• Ethical and Patent issues in nanotechnology</li> </ul>                                                                                                                                                                                                                  |                   |

### References:

1. Nanotechnology Principles and Practices -Sulabha K. Kulkarni (auth.) Nanotechnology Principles and Practices - Springer, International Publishing (2015)
2. Nanoscale materials -Liz Marzan and Kamat.
3. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
4. Nanomedicine in drug delivery - Arun Kumar - CRC Press - Taylor & Francis (2013)
5. E.Garit. Plenty of room for biology at the bottom: An introduction to bionanotechnology. Imperial College Press (2006)
6. A laboratory course in nanoscience and nanotechnology-Poinern, Gerrard Eddy Jai . CRC, Press, 2014

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5202      Course Name: Lab Course on 24ScBioU5201**

**Teaching Scheme: P: 4 Hours/Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks      End-Sem: 30 Marks**

**Prerequisite Courses:**

12<sup>th</sup> with basic understanding of Chemistry, Physics and Biology

**Course Objectives:**

To Study the process of generation of nanoparticles

To learn the characterization of nanoparticles

**Course Contents:**

| Practical   | Topic                                                      | 15 Practical |
|-------------|------------------------------------------------------------|--------------|
| Practical 1 | To study working of UV-Visible spectrophotometer.          | 2            |
| Practical 2 | To study Absorption spectrum of FeCl <sub>3</sub> Solution | 2            |
| Practical 3 | Synthesis of silver nanoparticles using chemical method    | 3            |
| Practical 4 | Synthesis of silver nanoparticles using biological method  | 3            |
| Practical 5 | Absorption spectrum of silver nanoparticles                | 2            |
| Practical 6 | To study X-ray diffraction pattern.                        | 2            |
| Practical 7 | Industrial visit                                           | 1            |

**References:**

- 1.Nanotechnology Principles and Practices -Sulabha K. Kulkarni (auth.) Nanotechnology Principles and Practices - Springer, International Publishing (2015)
- 2.Nanoscale materials -Liz Marzan and Kamat.
3. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
4. Nanomedicine in drug delivery - Arun Kumar - CRC Press - Taylor & Francis (2013)
5. E.Garit. Plenty of room for biology at the bottom: An introduction to bionanotechnology. Imperial College Press (2006)
- 6.A laboratory course in nanoscience and nanotechnology-Poinern, Gerrard Eddy Jai . CRC, Press, 2014

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**Third Year of B.Sc. (Biotechnology)**

**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5203**

**Course Name: Plant Tissue Culture**

**Teaching Scheme: TH: 2 Hours/Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20Marks**

**End-Sem: 30 Marks**

**Prerequisite:** Knowledge of Plant Science

**Course Objectives:** To understand Plant tissue culture techniques

**Course Outcomes:**

**On completion of the course, student will be able to–**

| CO No. | Course Outcomes (COs)                                                                                                          | Blooms Cognitive Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO 1   | Relate basic concepts from cell biology and botany.                                                                            | 1                      |
| CO 2   | Demonstrate various <i>in vitro</i> techniques.                                                                                | 2                      |
| CO 3   | Experiment with various plant materials using <i>in vitro</i> techniques for optimization of nutrients and culture conditions. | 3                      |
| CO 4   | Analyze significance of various culture techniques to face challenges in agriculture and plant science.                        | 4                      |
| CO 5   | Justify use of culture techniques beneficially over conventional methods of plant breeding.                                    | 5                      |
| CO 6   | Build economically viable protocols using various skills and techniques in plant tissue culture.                               | 6                      |

**Course Contents**

| Unit   | Topic                                                                                                                                                                                                                                                                                    | 30 Lectures       |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Unit 1 | <b>Concept of Plant Tissue culture</b>                                                                                                                                                                                                                                                   | <b>2 lectures</b> |
|        | <ul style="list-style-type: none"><li>• Concepts of Cell theory &amp; Cellular totipotency,</li><li>• Scientists contribution to plant tissue culture.</li></ul>                                                                                                                         |                   |
| Unit 2 | <b>Basics Facilities of Plant Tissue culture</b>                                                                                                                                                                                                                                         | <b>2 lectures</b> |
|        | <ul style="list-style-type: none"><li>• Laboratory design of plant tissue culture laboratory – Research and Commercial Lab</li><li>• General &amp; aseptic laboratory, different work areas,</li><li>• Principle and Working of equipments &amp; instruments required in PTC .</li></ul> |                   |
| Unit 3 | <b>Aseptic Techniques</b>                                                                                                                                                                                                                                                                | <b>2 lectures</b> |

|               |                                                                                                                                                                                                                                                                                                                                                                             |                    |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|               | <ul style="list-style-type: none"> <li>Washing &amp; preparation of glassware, packing &amp; sterilization: packing &amp; sterilization of Glassware plastic ware and Instruments</li> <li>Media sterilization and surface sterilization, Unit of energy and pressure</li> <li>Precautions to maintain aseptic conditions in PTC Lab</li> </ul>                             |                    |
| <b>Unit 4</b> | <b>Media Preparation</b>                                                                                                                                                                                                                                                                                                                                                    | <b>3 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>Units for solution preparation</li> <li>Media Composition: inorganic salt, carbon and energy source organic supplements gelling agents pH</li> <li>General methodology for medium preparation.</li> <li>Different types media used in PTC</li> <li>PGRs and their <i>in vitro</i> roles for growth and development in PTC</li> </ul> |                    |
| <b>Unit 5</b> | <b>Micropropagation</b>                                                                                                                                                                                                                                                                                                                                                     | <b>3 lectures</b>  |
|               | <ul style="list-style-type: none"> <li>Explant: Used for plant tissue culture</li> <li>Response of explants <i>in vitro</i> – Dedifferentiation and redifferentiation</li> <li>Different Stages of Micropropagation</li> <li>Applications of Micropropagation</li> </ul>                                                                                                    |                    |
| <b>Unit 6</b> | <b>Techniques of Plant tissue culture</b>                                                                                                                                                                                                                                                                                                                                   | <b>18 lectures</b> |
|               | <b>Callus culture technique –</b> <ul style="list-style-type: none"> <li>Introduction, Types of callus, Factors affecting, protocol, Morphology &amp; internal structure of callus, Maintenance of callus, Applications and limitations</li> </ul>                                                                                                                          | 2                  |
|               | <b>Suspension culture technique –</b> <ul style="list-style-type: none"> <li>Introduction, Types, Culture medium, Protocol, Synchronization, maintenance of cultures.</li> <li>Assessment of growth measurements and Viability</li> <li>Applications and limitations</li> </ul>                                                                                             | 2                  |
|               | <b>Organogenesis :</b> <ul style="list-style-type: none"> <li>Introduction, Types of organogenesis (direct and indirect), Protocol</li> <li>Factors affecting Organogenesis</li> <li>Applications and limitations</li> </ul>                                                                                                                                                | 1                  |
|               | <b>Somatic embryogenesis</b> <ul style="list-style-type: none"> <li>Introduction, types of embryogenesis (direct and indirect),</li> <li>Stages of somatic embryogenesis.</li> </ul>                                                                                                                                                                                        | 2                  |

|  |                                                                                                                                                                                                                                                                                            |   |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|  | <ul style="list-style-type: none"> <li>• Induction, development and maturation of SE.</li> <li>• Factors affecting somatic embryogenesis</li> <li>• Advantages and disadvantages</li> </ul>                                                                                                |   |
|  | <b>Anther and pollen culture –</b> <ul style="list-style-type: none"> <li>• Introduction, Pretreatments and Protocol</li> <li>• Pathways of development</li> <li>• Factors affecting</li> <li>• Advantages and disadvantages</li> </ul>                                                    | 2 |
|  | <b>Organ culture technique –</b> <ul style="list-style-type: none"> <li>• Introduction, Protocol, factors affecting w.r.t.</li> <li>• Root tip culture,</li> <li>• Leaf culture,</li> <li>• Shoot tip &amp;</li> <li>• Meristem culture,</li> <li>• Importance of Organ culture</li> </ul> | 3 |
|  | <b>Ovary, ovule, embryo and endosperm culture.</b> <ul style="list-style-type: none"> <li>• Introduction, Types of culture, Protocol</li> <li>• Factors affecting</li> <li>• Applications and limitations</li> </ul>                                                                       | 1 |
|  | <b>Protoplast –isolation, culture and fusion</b> <ul style="list-style-type: none"> <li>• Introduction, Different methods, Protocol</li> <li>• Factors affecting</li> <li>• Applications and limitations</li> </ul>                                                                        | 3 |
|  | <b>Cryopreservation—</b> <ul style="list-style-type: none"> <li>• Introduction, Principle, Different methods</li> <li>• Steps of cryopreservation techniques</li> <li>• Factors affecting</li> <li>• Applications and limitations</li> </ul>                                               | 1 |
|  | <ul style="list-style-type: none"> <li>• Applications of plant tissue culture in research and commercial Industry</li> </ul>                                                                                                                                                               | 1 |

### References:

1. Razdan M.K. (2009) - Introduction to Plant Tissue culture (Oxford & IBH Publ, NewDelhi)
2. Bhojwani S.S. &Razdan M.K. (1996) (2016)- Plant Tissue Culture : Theory & Practice(Elsevier, New Delhi)
3. Jha TB &Ghosh B (2017) – Plant tissue culture: Basic and applied (Universities Press,Hyderabad) and latest editions
4. Plant Tissue culture (2010) – Kalyan Kumar De (New central Book AgencyCalactta)
5. Methods In Plant Tissue culture – (2003) U Kumar Agrobios India

6. Plant cell culture Technology—MM Yeomen (2012) Blackwell

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**Third Year of B.Sc. (Biotechnology)**

**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5204**

**Course Name: Lab Course on 24ScBioU5203**

**Teaching Scheme: TH: 2 Hours/Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20Marks**

**End-Sem: 30 Marks**

**Prerequisite:** Knowledge of Plant Science

**Course Objectives:** To understand Plant tissue culture technique.

**Course Contents:**

| <b>Practical</b>   | <b>Topic</b>                                                                                                                                                                                                                     | <b>15 Practical</b> |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Practical 1</b> | <b>Laboratory Organization</b>                                                                                                                                                                                                   | <b>1 Practical</b>  |
| <b>Practical 2</b> | <b>Lab-ware Preparation for Aseptic transfer</b>                                                                                                                                                                                 | <b>1 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Washing of Glass ware/ plastic ware Glassware preparation for sterilization</li> <li>• Capping/plugging, packing &amp; sterilization, safety precautions</li> </ul>                     |                     |
| <b>Practical 3</b> | <b>Stock solutions and Media preparation</b>                                                                                                                                                                                     | <b>3 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Stock solutions calculations and preparation</li> <li>• Growth hormone calculation and preparation</li> <li>• Calculation for media Preparation</li> <li>• Media preparation</li> </ul> |                     |
| <b>Practical 4</b> | <b>Callus culture Technique</b>                                                                                                                                                                                                  | <b>2 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Callus culture technique - Initiation of culture and callus morphology</li> <li>• Explants: leaf disks and wounded explant</li> </ul>                                                   |                     |
| <b>Practical 5</b> | <b>Cell Suspension Culture</b>                                                                                                                                                                                                   | <b>3 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Initiation of cell suspension culture</li> <li>• Study of biochemical parameters (Haemocytometer and Packed Cell Volume)</li> </ul>                                                     |                     |
| <b>Practical 6</b> | <b>Meristem Culture</b>                                                                                                                                                                                                          | <b>2 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Initiation of shoot tip &amp; axillary bud culture</li> </ul>                                                                                                                           |                     |
| <b>Practical 7</b> | <b>Anther culture</b>                                                                                                                                                                                                            | <b>1 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• Anther and Pollen culture</li> </ul>                                                                                                                                                    |                     |
| <b>Practical 8</b> | <b>Embryo culture</b>                                                                                                                                                                                                            | <b>2 Practical</b>  |
|                    | <ul style="list-style-type: none"> <li>• To germinate <i>in vitro</i> monocot and dicot embryo</li> </ul>                                                                                                                        |                     |

References:

3. Plant Tissue culture (2010) – Kalyan Kumar De (New central Book Agency Calcutta)

4. Methods In Plant Tissue culture – (2003) U Kumar Agrobios India

5. Plant cell culture Technology—MM Yeomen (2012) Blackwell

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5501**

**Course Name: Critical Analysis of Scientific Paper and Scientific Writing**

**Teaching Scheme: P: 4 Hours/Week**

**Credit: 2C (15 P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

Basics of English, English Grammar

Basic Knowledge of scientific research concepts and scientific literature

**Course Objectives:**

To Study methods and types of research communication.

Understand different scientific research designs and methods

Learn how to set up a research study

Understand correct ways to refer to and cite from scientific literature

**Course Contents**

| Practical          | Topic                                                                                                                                                                                 | 15 Practicals |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Practical 1</b> | <b>Introduction</b>                                                                                                                                                                   |               |
|                    | <ul style="list-style-type: none"> <li>• What is Critical Thinking?</li> <li>• What is Scientific Writing?</li> <li>• Significance</li> <li>• Need</li> <li>• Applications</li> </ul> | <b>1</b>      |
| <b>Practical 2</b> | <b>Scientific Communication</b>                                                                                                                                                       |               |
|                    | <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Significance</li> <li>• Need</li> <li>• Types (Oral and Written)</li> </ul>                                          | <b>2</b>      |
| <b>Practical 3</b> | <b>Forms of Scientific Communication and Publications:</b>                                                                                                                            |               |
|                    | <ul style="list-style-type: none"> <li>• Case Study</li> <li>• Short Communication</li> <li>• Research Articles</li> <li>• Technical Reports</li> </ul>                               | <b>1</b>      |
| <b>Practical 4</b> | <b>IMRAD format:</b>                                                                                                                                                                  |               |
|                    | <ul style="list-style-type: none"> <li>• Research and Review Papers,</li> <li>• Project Reports,</li> <li>• Dissertation Report</li> </ul>                                            | <b>2</b>      |
| <b>Practical 5</b> | <b>Literature Review - Review Paper or Chapter in Report:</b>                                                                                                                         |               |
|                    | <ul style="list-style-type: none"> <li>• Process</li> <li>• Significance</li> <li>• Example</li> </ul>                                                                                | <b>2</b>      |
| <b>Practical 6</b> | <b>Result Analysis: Data Analysis and Data Representation:</b>                                                                                                                        | <b>2</b>      |
|                    | <ul style="list-style-type: none"> <li>• Tables</li> <li>• Graphs</li> <li>• Statistical tests</li> </ul>                                                                             |               |
| <b>Practical 7</b> | <b>Bibliography and Citation Styles:</b>                                                                                                                                              |               |
|                    | <ul style="list-style-type: none"> <li>• Citation Styles</li> <li>• Soft ware for reference management</li> </ul>                                                                     | <b>1</b>      |
| <b>Practical 8</b> | <b>Plagiarism and Ethics in Research:</b>                                                                                                                                             |               |
|                    | <ul style="list-style-type: none"> <li>• Concept and Types of Plagiarism</li> <li>• Soft ware for plagiarism checking</li> <li>• Ethics</li> </ul>                                    | <b>2</b>      |

|                    |                                                                                                                                                                                                                           |          |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Practical 9</b> | <b>Journals in Biotechnology:</b>                                                                                                                                                                                         | <b>1</b> |
|                    | <ul style="list-style-type: none"> <li>• How to search a good journal?</li> <li>• Good journal vs. Bad journal</li> <li>• Important links on Journal Website - Instruction to Authors as well as Aim and Scope</li> </ul> |          |
| <b>Practical10</b> | <b>Power Point Presentation:</b>                                                                                                                                                                                          |          |
|                    | <ul style="list-style-type: none"> <li>• Evaluation of any research</li> </ul>                                                                                                                                            | <b>1</b> |

#### References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition  
Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.  
Research Methodology – C.R.Kothari  
Health informatics research methods: principles and practice *Layman, Elizabeth; Watzlaf, Valerie J.* Chicago, Ill. : American Health Information Management Association, c2009. - xiii, 439 p. ISBN:978-1-58426-181-0 : \$85.95 LIBRIS-ID:12452928 [Library search](#)  
*Denscombe, Martyn.* The good research guide [Elektroniskresurs] : for small-scale social research projects 4th ed. : Maidenhead : Open University Press, cop.2010. - 373 p. ISBN:9780335241408 (electronic bk.) LIBRIS-:12194897 [Library search](#)

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**Third Year of B.Sc. (Biotechnology**  
**(NEP 2020 under 2024 Pattern) Semester V**

**Course Code: 24ScBioU5001**

**Course Name: Field Project II**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Project work, Thesis Submission & presentation**

- Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department./Research Institute/Industry
- Project work / Thesis / Dissertation shall be pursued for a minimum of 12 weeks during the final semester.
- The Project Report/Thesis / Dissertation report is to be prepared as per standard scientific research methodology and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the department.
- The assessment (Internal and external) of the project work will be as per guidelines.

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**Third Year of B.Sc. Biotechnology**  
**(2024 Course) Semester V**

**Course Code: 24ScBioU5302**

**Course Name: Lab Course on Applications of Biotechnology**

**Teaching Scheme: P: 4hrs./week**

**Credit : 2C(2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite:** Basic concepts of biotechnology

**Course Objectives:**

To understand the basic concepts of biotechnology used in industry.

**Course contents:**

|                  | <b>Practicals in Applications in Biotechnology</b> |                        |
|------------------|----------------------------------------------------|------------------------|
| <b>Practical</b> | <b>Topic</b>                                       | <b>Practicals (15)</b> |

|                    |                                                                                                                                                                                               |          |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Practical 1</b> | <b>Sickle cell Anemia</b>                                                                                                                                                                     | <b>1</b> |
|                    | <ul style="list-style-type: none"> <li>Detection of Sickle cell Anemia from human blood</li> </ul>                                                                                            |          |
| <b>Practical 2</b> | <b>Bacterial Enzyme Production</b>                                                                                                                                                            | <b>3</b> |
|                    | <ul style="list-style-type: none"> <li>Production of enzyme (Amylase/ Cellulase/ Lipase)</li> <li>Purification of enzyme (recipitation/ Dialysis)</li> <li>Industrial Applications</li> </ul> |          |
| <b>Practical 3</b> | <b>Plasmid Curing</b>                                                                                                                                                                         | <b>2</b> |
|                    | <ul style="list-style-type: none"> <li>Curing of plasmid from bacteria using Acridine orange (Antibiotic resistance plasmid)</li> </ul>                                                       |          |
| <b>Practical4</b>  | <b>Gene Editing</b>                                                                                                                                                                           | <b>4</b> |
|                    | <ul style="list-style-type: none"> <li>Gene editing using CRISPR- cas system</li> </ul>                                                                                                       |          |
| <b>Practical 5</b> | <b>Sterility Testing</b>                                                                                                                                                                      | <b>1</b> |
|                    | <ul style="list-style-type: none"> <li>Sterility testing of injectable or autoclave</li> </ul>                                                                                                |          |
| <b>Practical 6</b> | <b>Study of Secondary metabolite</b>                                                                                                                                                          | <b>2</b> |
|                    | <ul style="list-style-type: none"> <li>Bioassay</li> <li>Minimum Inhibitory Assay (MIC)</li> <li>Minimum Bactericidal Assay (MBC)</li> </ul>                                                  |          |
| <b>Practical 7</b> | <b>Gene Finding</b>                                                                                                                                                                           | <b>1</b> |
|                    | <ul style="list-style-type: none"> <li>Finding start and stop codon using R</li> </ul>                                                                                                        |          |
| <b>Practical 8</b> | <b>Phylogenetic Analysis</b>                                                                                                                                                                  | <b>1</b> |
|                    | <ul style="list-style-type: none"> <li>Phylogenetic analysis using PHYLIP</li> <li>Rooted tree/ Unrooted tree</li> </ul>                                                                      |          |

#### References:

1. Patel, A. H., Industrial Microbiology, 2nd edition, (2016), Laxmi Publications, New Delhi.
2. Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press
3. Primrose, S. B., & Twyman, R. (2013). Principles of gene manipulation and genomics. John Wiley & Sons
4. Prescott's Microbiology, Joanne M. Willey , Linda M. Sherwood , Christopher J. Woolverton 8th Edition McGraw-Hill Publishers Eight edition- 2010.



## SEM VI

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**Third Year of B.Sc. Biotechnology**  
**(NEP 2020 under 2024 pattern) Semester VI**

**Course Code: 24ScBioU6101**

**Course Name: Biophysical and Biochemical Techniques**

**Teaching Scheme: TH: 2 Hours / Week**

**Credit: 2C(2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

### **Prerequisite Courses:**

The course deals with details of pragmatic requirements of techniques involved in biotechnology. Hence students should have introduction to basic terminologies in biochemistry and biophysics.

### **Course Objectives:**

To understand the basis of solution preparation together with understanding the principle, working and applications of different biochemical techniques required in various biotechnological field. The course integrates theory and practical use to ensure students understand why and how these techniques are used.

### **Course Outcomes:**

On completion of the course, student will be able to

| <b>CO No.</b> | <b>Course Outcomes</b>                                                                                        | <b>Blooms Cognitive Level</b> |
|---------------|---------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Tell principle, working and instrumentation of centrifugation techniques.                                     | 1                             |
| CO2           | Explain relationship between R-g and types of centrifuges.                                                    | 2                             |
| CO3           | . Solve problems based on Henderson-Hasselbach Equation and Recall basic concepts of acid, bases and buffers. | 3                             |

|     |                                                                                     |   |
|-----|-------------------------------------------------------------------------------------|---|
| CO4 | Analyze principle and working of advanced microscopic and spectroscopic techniques. | 4 |
| CO5 | Choose chromatographic techniques based on sample to be separated.                  | 5 |
| CO6 | Discuss principle, working and applications of electrophoresis techniques.          | 6 |

### Course Contents

| Units | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 30 Lectures |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit1 | Centrifugation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 7 Lectures  |
|       | <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Basic principles of sedimentation: Centrifugal Force, R and g concept and difference</li> <li>• Problems based on R and g conversion</li> <li>• Basic Instrumentation</li> <li>• Rotors and its types</li> <li>• Types of centrifugation: Principle and working of Differential Centrifugation, Density Gradient Centrifugation</li> <li>• Preparative centrifugation, Analytical centrifugation</li> <li>• Care and maintenance of centrifuge</li> </ul> |             |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>Unit 2</b> | <b>Solutions and Buffers</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Standard solution and Standard Substance</li> <li>• Concentration of solutions</li> <li>• Strong acids and bases, weak acids and bases</li> <li>• Biochemical importance of weak electrolytes</li> <li>• Buffers: Definition, solutions preparation</li> <li>• Buffer capacity, Selection of a buffer</li> <li>• Biological Buffer: definition, example and Significance</li> </ul>                                                                                                                                                                                                 |                   |
| <b>Unit 3</b> | <b>Advanced microscopy and spectroscopy</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>8 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Light concept and Refractive Index</li> <li>• Electromagnetic radiations: dual nature and properties.</li> <li>• Definition and concept of wavelength, frequency, Energy Levels in Atoms &amp; Molecules</li> <li>• Introduction to microscopy: Basic microscope parts and their working</li> <li>• Preparation of specimens for different types of microscopy</li> <li>• Phase contrast microscopy</li> <li>• Fluorescence microscopy</li> <li>• Electron Microscopy</li> <li>• Atomic Force Microscopy</li> <li>• Colorimeter and UV-visible spectrophotometer</li> </ul>         |                   |
| <b>Unit 4</b> | <b>Advanced Separation Techniques</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• General principle of Electrophoresis</li> <li>• Agarose gel electrophoresis of DNA</li> <li>• Native and SDS PAGE, Isoelectric focusing</li> <li>• Pulsed-field gel electrophoresis, Capillary electrophoresis</li> <li>• Definition and concept of chromatography,</li> <li>• Thin layer chromatography, Paper chromatography</li> <li>• Column chromatography –Size exclusion chromatography, Ion-exchange (Principle, working and applications of each), Affinity chromatography (Concept)</li> <li>• Advanced chromatography Techniques: Introduction to HPLC and GC</li> </ul> |                   |

#### References:

1. Principles and techniques of biochemistry and molecular biology. Seventh edition. Keith Wilson, John Walker. (2010). Cambridge University Press, United Kingdom.
2. Biophysical Chemistry (Principles and technique, Revised edition. ( 2009). Avinash Upadhyay, Kakoli Upadhya, Nirmalendu Nath. Himalaya publishing house pvt. Ltd, India.

3. Instrumental methods of analysis. Second Edition. (2012). B.Sivasankar. Oxford University Press, New Delhi.
4. Biochemical calculation. Second edition. (1976). Irwin Segal. John Willey and Sons Ltd., USA.
5. Biophysics, an introduction. First edition. (2002). Cotteril R. John Willey and Sons Ltd., USA

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester VI**

**Course Code: 23ScBioU6102**

**Course Name: Agricultural Biotechnology**

**Teaching Scheme: TH: 2 Hours / Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

To know Basic agriculture and its applications

**Course Objectives:**

To Study Skill development in all crucial tasks of the Agriculture industry

To learn Structure, functioning, objective and mandates of the Agri based Industries

**Course Outcomes:**

| CO No. | Course Outcomes (COs)                          | Bloom's cognitive taxonomy level |
|--------|------------------------------------------------|----------------------------------|
| CO 1   | Get placements in Agro- and Cottage industries | 1                                |
| CO 2   | Seed/Sapling production units                  | 2                                |
| CO 3   | Pesticide-insecticide production units         | 3                                |
| CO 4   | Post-harvest processing firms,                 | 4                                |
| CO 5   | Agri-finance institutions                      | 5                                |
| CO 6   | Develop agricultural based cottage units       | 6                                |

**Course Contents:**

| Unit   | Topic                                                                                                                                                                                                                                            | 30 Lectures |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit 1 | Introduction to Agriculture                                                                                                                                                                                                                      | 7 Lectures  |
|        | <ul style="list-style-type: none"><li>• Agriculture and its scope, Crop nutrition, and fertilizers,</li><li>• Water resources, soil-plant-water relationship</li><li>• Crop rotation and its principles, crop management technologies.</li></ul> |             |

|               |                                                                                                                                                                                                                                                                                      |                   |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|               |                                                                                                                                                                                                                                                                                      |                   |
| <b>Unit 2</b> | <b>Organic Farming</b>                                                                                                                                                                                                                                                               | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Principles and scope of organic farming in India</li> <li>• Choice of crops and varieties in organic farming</li> <li>• Contract Farming: concept and scope</li> </ul>                                                                      |                   |
| <b>Unit 3</b> | <b>Soil Science</b>                                                                                                                                                                                                                                                                  | <b>5 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Soil as a natural body, soil forming, rocks and minerals, Soil Profile, Components of soil</li> <li>• Soil: taxonomy, classification and types of soils in India</li> </ul>                                                                 |                   |
| <b>Unit 4</b> | <b>Conventional and Hi-Tech Agriculture</b>                                                                                                                                                                                                                                          | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Conventional Plant propagation-methods and propagating structures</li> <li>• Importance and advantages of hi tech propagation, Site selection, irrigation system , irrigation system Maintenance of Poly house,</li> </ul>                  |                   |
| <b>Unit 5</b> | <b>Mushroom Cultivation</b>                                                                                                                                                                                                                                                          | <b>6 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• A study on morphology of mushroom</li> <li>• Introduction to mushroom types</li> <li>• Cultivation of mushrooms examples</li> <li>• Oyster mushroom (<i>Pleurotus spp.</i>),</li> <li>• Harvesting and preservation of mushrooms</li> </ul> |                   |

#### References:

1. Introduction to plant biotechnology (Science Publ); Chawla HC (2004)

2. Plant pigments and their manipulation – Annual plant reviews, vol 14 (Blackwell Publ); Davie K (Ed) (2004)
3. Plant Biotechnology and agriculture Prospects for the 21st century (Academic press); Altman A, Hasegawa PM (Ed) (2012).
4. Plant Tissue Culture: Theory & Practice (Elsevier); Bhojwani SS. & Razdan MK (1996).
5. Biocatalysis and agricultural biotechnology (CRC Press); Hou CT, Shaw JF (2009).
6. Plant Biotechnology: the genetic manipulation of plants (Oxford Press); Slater A, Scott NW, Fowler MR (2008).
7. Fungal Biotechnology (IK International); Rai M (2009).
8. Plant cell and tissue culture (Springer); Vasil IK, Thorpe TA (1994).
9. Textbook of Biotechnology 4th edition; H K Das.
10. Singh BD. 2015. Plant Breeding Principles and Methods. Kalyani Publishers, New Delhi.
11. Parsad Jagdish. 2001. Poultry Production and Management. Kalyani Publishers. 3.
12. Thomas CK & Sastry N.S.R. 2013. Livestock Production Management. Kalyani Publishers.
13. Dr. M.T. Patil and Dr. P.V. Patil Commercial protected floriculture, Indian Council & Agricultural Research New Delhi
14. Chang ST, Philip G, Miles, (2004) Mushroom Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact, 2<sup>nd</sup> Edn. CRC Press. USA.
15. Bahl N. (1994). Handbook on Mushroom New Delhi.

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester VI**

**Course Code:**24ScBioU6103  
**Technology**

**Course Name:** Recombinant DNA

**Teaching Scheme:** TH: 2Hours/Week

**Credit:** 2 C (2T)

**Examination Scheme:** CIA: 20 Marks

**End-Sem:** 30 Marks

**Prerequisite Courses:**

Basics of Molecular Biology

**Course Objectives:**

To learn the basic concept of genetic modifications to obtain the desired product.

To study different techniques used in Genetic engineering.

To learn the progress in the field of Recombinant DNA technology.

**Course Outcomes:**

On completion of the course, student will be able to–

| CO No. | Course Outcomes (COs)                                                                      | Bloom's cognitive taxonomy level |
|--------|--------------------------------------------------------------------------------------------|----------------------------------|
| CO 1   | Define the historical perspective of rDNA technology and its relation to Molecular Biology | 1                                |
| CO 2   | Outline the basic concept of rDNA technology tools and techniques.                         | 2                                |
| CO 3   | Identify the various transformation and transformant selection techniques.                 | 3                                |
| CO 4   | List of various vectors used in gene cloning.                                              | 4                                |
| CO 5   | Understand the importance of PCR and gene sequencing techniques.                           | 5                                |
| CO 6   | Design and application of gene cloning and DNA analysis.                                   | 6                                |

## Course Contents

| Unit   | Topic                                                                                                                                                                                                                                                                                                                                                                                                        | 30 Lectures |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Unit 1 | <b>Introduction to Recombinant DNA Technology</b>                                                                                                                                                                                                                                                                                                                                                            | 2 Lectures  |
|        | <ul style="list-style-type: none"> <li>• Historical perspective</li> <li>• Overview of Recombinant DNA Technology</li> </ul>                                                                                                                                                                                                                                                                                 |             |
| Unit 2 | <b>Molecular tools used in Recombinant DNA Technology</b>                                                                                                                                                                                                                                                                                                                                                    | 3 Lectures  |
|        | <ul style="list-style-type: none"> <li>• Different enzymes – Restriction enzymes, Ligases, Polymerases, Alkaline Phosphatases, Nucleases, Transferases</li> <li>• Introduction to PCR technology: Steps in PCR, Factors affecting PCR, Applications of PCR</li> </ul>                                                                                                                                        |             |
| Unit 3 | <b>Vectors used in Recombinant DNA Technology</b>                                                                                                                                                                                                                                                                                                                                                            | 4 Lectures  |
|        | <ul style="list-style-type: none"> <li>• Plasmids</li> <li>• Bacteriophages and M13</li> <li>• Expression vectors: pET Vector</li> <li>• Agrobacterial Vectors – pTi plasmid</li> <li>• YAC, BAC</li> <li>• Chimeric Vectors -</li> <li>• Cosmids: Single Cos cosmids and Dual cos cosmids</li> <li>• Phasmids: □ZAP series</li> <li>• Phagemids: pGEMZf series, pEMBL8</li> <li>• Fosmids: pFOS1</li> </ul> |             |
| Unit 4 | <b>Transformation: Techniques of introduction of DNA into the host cell</b>                                                                                                                                                                                                                                                                                                                                  | 6 Lectures  |
|        | <ul style="list-style-type: none"> <li>• Methods of introduction of DNA into: Bacterial cell, Animal cell and Plant cell.</li> <li>• Selection and Characterization of transformants</li> </ul>                                                                                                                                                                                                              |             |

|               |                                                                                                                                                                                                                                                                       |                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|               |                                                                                                                                                                                                                                                                       |                   |
| <b>Unit 5</b> | <b>Purification of DNA from living cells and yield analysis</b>                                                                                                                                                                                                       | <b>4 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Purification of Total cellular / chromosomal DNA and its characterization</li> <li>• Purification of Plasmid DNA – Plasmid Characterization</li> <li>• Purification of Bacteriophage DNA and its characterization</li> </ul> |                   |
| <b>Unit 6</b> | <b>Sequencing of Genes and Genomes</b>                                                                                                                                                                                                                                | <b>2 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Maxam Gilbert's method</li> <li>• Sanger's Manual method</li> <li>• Automated DNA sequencing</li> </ul>                                                                                                                      |                   |
| <b>Unit 7</b> | <b>Genome Mapping</b>                                                                                                                                                                                                                                                 | <b>2 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Techniques of Genome mapping: Physical and Genetic</li> <li>• DNA Fingerprinting</li> </ul>                                                                                                                                  |                   |
| <b>Unit 8</b> | <b>Construction of Genomic and cDNA Library</b>                                                                                                                                                                                                                       | <b>2 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Process of library construction</li> <li>• Comparison between Genomic and cDNA library</li> </ul>                                                                                                                            |                   |
| <b>Unit 9</b> | <b>Applications of Recombinant DNA Technology and Guidelines to create genetically modified organisms</b>                                                                                                                                                             | <b>5 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Application in Agriculture</li> <li>• Application in Food Industry</li> <li>• Application in healthcare and Pharmaceutical industry</li> </ul>                                                                               |                   |

### References:

1. Gene Cloning and DNA Analysis –An Introduction. T.A. Brown. Eighth Edition (2020). Wiley Blackwell.
2. Genetic Engineering. By Smita Rastogi and Neelam Pathak. Oxford University Press (2009).
3. Principles of Gene Manipulation & Genomics, 7th Edition (2006), Primrose and Twyman, Blackwell Publishing, USA.
4. Molecular Biology of the Gene, 7th Edition (2013), James D. Watson, Tania Baker,

5. Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education, Inc.
6. Genomes 3. T.A. Brown. Third Edition (2008). Garland Science Taylor and Francis Group, New York and London.

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**Third Year of B.Sc. Biotechnology**  
**(NEP 2020 under 2024 Pattern) Semester VI**

**Course Code: 24ScBioU6105 Course Name: Lab Course on 24ScBioU6101 & 24ScBioU6102**

**Teaching Scheme: TH: 4 Hours / Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

The course deals with details of pragmatic requirements of techniques involved in biotechnology. Hence students should have introduction to basic terminologies in biochemistry and biophysics.

**Course Objectives:**

To understand the basis of solution preparation together with understanding the principle, working and applications of different biochemical techniques required in various biotechnological field. The course integrates theory and practical use to ensure students understand why and how these techniques are used.

| <b>Practicals</b>  | <b>Topic</b>                                                                                                                                                                | <b>15 Practical</b> |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Practical 1</b> | <b>Buffer Preparation</b>                                                                                                                                                   | <b>1 practical</b>  |
|                    | <ul style="list-style-type: none"><li>To study preparation of buffer of given pH by preparing given percentage, molar and normal solutions.</li></ul>                       |                     |
| <b>Practical 2</b> | <b>Colorimetry</b>                                                                                                                                                          | <b>1 practical</b>  |
|                    | <ul style="list-style-type: none"><li>To study Beer-Lambert's law and to determine relationship between absorbance and concentration using standard graph method.</li></ul> |                     |
| <b>Practical 3</b> | <b>Density Gradient Centrifugation</b>                                                                                                                                      | <b>1 practical</b>  |
|                    | <ul style="list-style-type: none"><li>Purification of the given sample (protein/enzyme/other) by using sucrose density gradient centrifugation</li></ul>                    |                     |
| <b>Practical 4</b> | <b>Statistical Analysis</b>                                                                                                                                                 | <b>1 practical</b>  |
|                    | <ul style="list-style-type: none"><li>To solve problems based on T test.</li></ul>                                                                                          |                     |

|                     |                                                                                                                                                                                                                                                                                                                      |                     |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Practical 5</b>  | <b>Electrophoresis &amp; Activity Staining</b>                                                                                                                                                                                                                                                                       | <b>1 practical</b>  |
|                     | <ul style="list-style-type: none"> <li>To perform Native gel electrophoresis for activity staining.</li> </ul>                                                                                                                                                                                                       |                     |
| <b>Practical 6</b>  | <b>Fluorescence observation</b>                                                                                                                                                                                                                                                                                      | <b>1 practical</b>  |
|                     | <ul style="list-style-type: none"> <li>To observe the fluorescence of the given sample</li> </ul>                                                                                                                                                                                                                    |                     |
| <b>Practical 7</b>  | <b>Estimation of Ascorbic acid</b>                                                                                                                                                                                                                                                                                   | <b>1 practical</b>  |
|                     | <ul style="list-style-type: none"> <li>To estimate ascorbic acid in given sample by volumetric method.</li> </ul>                                                                                                                                                                                                    |                     |
|                     | <b>Agricultural Biotechnology</b>                                                                                                                                                                                                                                                                                    | <b>Practical</b>    |
| <b>Practical 8</b>  | <b>Anemometer, Rain Gauge</b>                                                                                                                                                                                                                                                                                        | <b>2 Practicals</b> |
|                     | <ul style="list-style-type: none"> <li>To record temperature ,wind speed, and rain fall of the atmosphere.</li> <li>To determine the biomass of a particular area.</li> <li>To estimate the available nutrient status ,reaction ( acidity/alkaline) of a soil.</li> </ul>                                            |                     |
| <b>Practical 9</b>  | <b>Soil Testing</b>                                                                                                                                                                                                                                                                                                  | <b>2 Practicals</b> |
|                     | <ul style="list-style-type: none"> <li>To determine and compare the humus contents of polluted and unpolluted soils</li> <li>To test the presence of phosphate , Sulphate , and Chloride in the soil</li> <li>To measure the temperature of soil and air</li> <li>To measure humidity and light intensity</li> </ul> |                     |
| <b>Practical 10</b> | <b>Mushroom Cultivation</b>                                                                                                                                                                                                                                                                                          | <b>3 Practicals</b> |
|                     | <ul style="list-style-type: none"> <li>To determine the presence of carbonates in the given soil sample</li> <li>A study of mushroom morphology</li> <li>Preparation of spawn</li> <li>Cultivation of Oyster mushroom ( Pleurotus spp.)</li> </ul>                                                                   |                     |
| <b>Practical 11</b> | <b>Polyhouse technology</b>                                                                                                                                                                                                                                                                                          | <b>1 Practical</b>  |

|  |                                                                                                    |  |
|--|----------------------------------------------------------------------------------------------------|--|
|  | <ul style="list-style-type: none"> <li>• Importance of Polyhouse</li> <li>• Field Visit</li> </ul> |  |
|--|----------------------------------------------------------------------------------------------------|--|

### References:

1. Parsad Jagdish. 2001. Poultry Production and Management.Kalyani Publishers.
- 2.Thomas CK &Sastry N.S.R. 2013.Livestock Production Management.Kalyani Publishers.
3. Dr. M.T. Patil and Dr. P.V. Patil Commercial protected floriculture, Indian Council &Agricultural Research New Delhi
4. Chang ST, Philip G, Miles ,(2004) Mushroom Cultivation, Nutritional Value , Medicinal Effect ,and Environmental Impact , 2<sup>nd</sup>Edn. CRC Press. USA.
5. Bahl.N.(1994). Handbook on Mushroom New Delhi.
6. Instrumental methods of analysis. Second Edition. (2012). B.Sivasankar. Oxford University Press, New Delhi.
- 7Biochemical calculation. Second edition. (1976). Irwin Segal. John Willey and Sons Ltd., USA.
8. Biophysics, an introduction. First edition. (2002). Cotteril R. John Willey and Sons Ltd., USA

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**Third Year of B.Sc. (Biotechnology)**  
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**Course Code: 24ScBioU6106**

**Course Name: Lab course on 24ScBioU6103**

**Teaching Scheme: P: 4 Hours/Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem:30 Marks**

**Prerequisite Courses:**

Basics of Molecular Biology and Genetic Engineering

**Course Objectives:**

To Study DNA isolation techniques from Plant, Animal and Bacterial cells

To perform the techniques of introduction of DNA into the cells.

**Course contents**

| Practical   | Topic                                                                                                                                                 | 15 practicals |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Practical 1 | Genomic DNA Isolation and its characterization<br>(Qualitative / Quantitative)                                                                        | 4             |
|             | <ul style="list-style-type: none"><li>Isolation of Bacterial Chromosomal DNA</li><li>Isolation of Plant DNA</li><li>Isolation of Animal DNA</li></ul> |               |
| Practical 2 | Plasmid DNA Isolation and Gel Electrophoresis                                                                                                         | 2             |
| Practical 3 | DNA Ligation and Gel electrophoresis                                                                                                                  | 2             |
| Practical 4 | Restriction Mapping of the DNA sample and Gel electrophoresis                                                                                         | 2             |
| Practical 5 | Transformation of <i>E. coli</i> Cells:                                                                                                               | 3             |

|                    |                                                                                                                                                             |          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|                    | <ul style="list-style-type: none"> <li>• Preparation of Competent Cells</li> <li>• Transformation technique</li> <li>• Selection of Recombinants</li> </ul> |          |
| <b>Practical 6</b> | <b>PCR Reaction and Gel Electrophoresis</b>                                                                                                                 | <b>2</b> |

### References:

1. Molecular cloning – a laboratory manual – (Vol. 1-3), 4th edition, (2012), Green and Sambrook, Cold Spring Harbor Laboratory Press, USA

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**Third Year of B.Sc. (Biotechnology)**  
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**Course Code: 24ScBioU6201**

**Course Name: Food Biotechnology**

**Teaching Scheme: TH: 2 Hours / Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

Knowledge of food science up to 12<sup>th</sup>std.

**Course Objectives:**

To provide knowledge about techniques used in plant, animal and microbial biotechnology

To introduce students to new developments in the field of food biotechnology

**Course Outcome**

**On completion of the course, student will be able to–**

| <b>CO No.</b> | <b>Course Outcomes (COs)</b>                                                  | <b>Blooms Cognitive Level</b> |
|---------------|-------------------------------------------------------------------------------|-------------------------------|
| <b>CO 1</b>   | Define basic concepts in food science and food technology.                    | 1                             |
| <b>CO 2</b>   | Classify and compare various food constituents as molecules and nutrients.    | 2                             |
| <b>CO 3</b>   | Apply quality parameters to understand biochemistry and spoilage of food.     | 3                             |
| <b>CO 4</b>   | Analyze food of various types of using standard protocols                     | 4                             |
| <b>CO 5</b>   | Compare several techniques of food processing and preservation.               | 5                             |
| <b>CO 6</b>   | Discuss methods and protocols for food analysis, processing and preservation. | 6                             |

## Course Contents

| Unit          | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 30 Lectures        |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Unit 1</b> | <b>Introduction to Food Biotechnology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>10 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Introduction to food science and biotechnology</li> <li>• Basics of chemistry of food constituents- carbohydrates, proteins, lipids, vitamins, minerals, water (different forms of water present in foods and their effect on quality and preservation of foods),</li> <li>• Minor constituents affecting texture, color, taste, odor of food</li> <li>• Food microbiology, Food biochemistry, Food additives, General food composition and effect of food constituents on food quality.</li> </ul>                                                                                                                                  |                    |
| <b>Unit 2</b> | <b>Introduction to Standards for food analysis with suitable example</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>10 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Standards for food analysis Standards of identity, purity, and methodology for analysis of</li> <li>• Cereals,</li> <li>• legumes,</li> <li>• oil seeds and their products;</li> <li>• Fruits, vegetables, tubers, and their products;</li> <li>• Tea, coffee, cocoa, chocolate, spices, sugar, condiments</li> <li>• Milk and milk products</li> <li>• Meat, fish and poultry products;</li> <li>• Miscellaneous foods e.g. fermented products.</li> </ul>                                                                                                                                                                          |                    |
| <b>Unit 3</b> | <b>Food processing and preservation with suitable example</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>10 Lectures</b> |
|               | <ul style="list-style-type: none"> <li>• Introduction to food processing of various foods including dairy, bakery, brewing, fruit and vegetable products, plantation products, oilseeds, meat, fish, poultry; pro and prebiotics and nutraceuticals.</li> <li>• Principles of food preservation by dehydration, thermal treatments like pasteurization, sterilization, canning, retorting etc., low temperature i.e., chilling and freezing, chemical preservation/ bio-preservation, traditional methods like salting/ syrumping, pickling, fermentation etc., non- thermal processes like MAP, irradiation, high Pressure processing etc., and hurdle technology</li> </ul> |                    |

## References:

1. Potter, Norman N., Hotchkiss, Joseph H. (1995), Food Science, 5th Ed. Springer US.
2. Manay, S.; Shadaksharaswami, M., (2004). Foods: Facts and Principles, 4th Ed. New Age Publishers.
3. B. Srilakshmi., (2002), Food Science, New Age Publishers.

4. Meyer,(2004).Food Chemistry. New Age Publishers.
5. Deman JM.(1990) Principles of Food Chemistry.2<sup>nd</sup> ed.Van Nostrand Reinhold.
6. Ramaswamy H. and Marcott M.(2005), Food Processing Principles and Applications. CRC Press.

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester VI**

**Course Code: 24ScBioU6202**  
**24ScBioU6201**

**Course Name: Lab Course on**

**Teaching Scheme: TH: 4 Hours / Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite Courses:**

Knowledge of food science up to 12<sup>th</sup> std.

**Course Objectives:**

To provide knowledge about techniques used in plant, animal and microbial biotechnology

To introduce students to new developments in the field of food biotechnology

**Course Contents**

| Practical          | Topic                                                               | 15 Practical |
|--------------------|---------------------------------------------------------------------|--------------|
| <b>Practical 1</b> | Analysis of milk(liquid) & detection of Adulterants in milk         | <b>2</b>     |
| <b>Practical 2</b> | Analysis of grain flour and determination of damaged starch         | <b>2</b>     |
| <b>Practical 3</b> | Analysis of tea and coffee                                          | <b>2</b>     |
| <b>Practical 4</b> | Analysis of alcoholic beverages                                     | <b>1</b>     |
| <b>Practical 5</b> | Estimation of food bioactives (phenolics, pigments etc)             | <b>2</b>     |
| <b>Practical 6</b> | Detection of Food adulteration                                      | <b>2</b>     |
| <b>Practical 7</b> | Fruit and vegetable processing: Dehydration and Product Development | <b>1</b>     |
| <b>Practical 8</b> | Milk processing: Development of dairy product                       | <b>2</b>     |
| <b>Practical 9</b> | Visit to food industry                                              | <b>1</b>     |

**References:**

1. Potter, Norman N. ,Hotchkiss, Joseph H.(1995), Food Science,5thEd. Springer US

2. Manay,S.;Shadaksharaswami,M.,(2004).Foods:Facts and Principles,4thEd.New Age Publishers.
3. B. Srilakshmi.,(2002), Food Science, New Age Publishers.
4. Meyer,(2004).Food Chemistry. New Age Publishers.
5. Deman JM.(1990) Principles of Food Chemistry.2<sup>nd</sup> ed.Van Nostrand Reinhold, NY
6. Ramaswamy H. and Marcott M.(2005), Food Processing Principles and Applications. CRC Press.

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**Third Year of B.Sc. Biotechnology**  
**(NEP 2020 Under NEP 2024)Semester VI**

**Course Code: 24ScBioU6203**

**Course Name: Animal Tissue Culture**

**Teaching Scheme: TH: 2 Hours/Week**

**Credit: 2C (2T)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite:**

- ☐ Basics of Zoology from XI, XII science and F. Y. B. Sc. Biotechnology

**Course Objectives:**

To Study: history, methods, types and applications of animal tissue culture.

To learn how to culture animal cells in artificial conditions.

**Course Outcomes:**

**On completion of the course, student will be able to–**

| CO No. | Course Outcomes                                                               | Blooms Cognitive Level |
|--------|-------------------------------------------------------------------------------|------------------------|
| CO1    | Define and understand animal tissue culture.                                  | 1                      |
| CO2    | Explain types of cell culture methods.                                        | 2                      |
| CO3    | Model ideal laboratory design for animal tissue culture with instrumentation. | 3                      |
| CO4    | Analyze types cell lines and characterization strategies.                     | 4                      |
| CO5    | Evaluate importance of culture medium, nutrition and physiology.              | 5                      |
| CO6    | Elaborate on applications of animal tissue culture.                           | 6                      |

**Course Contents:**

| Chapter   | Topic                                                                                                                                                                                                                                                             | Lectures   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Chapter 1 | Introduction and history                                                                                                                                                                                                                                          | 2 lecture  |
|           | <ul style="list-style-type: none"><li>History of animal cell culture</li><li>Comparison with bacterial culture<ul style="list-style-type: none"><li><i>In vivo</i> v/s <i>in vitro</i> growth conditions for cells of multicellular organisms</li></ul></li></ul> |            |
| Chapter 2 | Basic concepts of ATC                                                                                                                                                                                                                                             | 3 lectures |

|                  |                                                                                                                                                                                                                                                                                                         |                   |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                  | <ul style="list-style-type: none"> <li>• Concept of monolayer, suspension, histotypic/ organotypic, organ culture</li> <li>• Maintenance of aseptic conditions.</li> <li>• Contamination, types of contaminants</li> <li>• Cross contamination</li> <li>• Disposal practices used in ATC lab</li> </ul> |                   |
| <b>Chapter 3</b> | <b>Equipment and infrastructure</b>                                                                                                                                                                                                                                                                     | <b>6 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Laboratory design</li> <li>• Instruments used in ATC</li> <li>• Labware: TC flasks</li> </ul>                                                                                                                                                                  |                   |
| <b>Chapter 4</b> | <b>Nutrition &amp; Physiology</b>                                                                                                                                                                                                                                                                       | <b>6 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Rationale behind medium formulation with examples</li> <li>• Advantages and disadvantages of serum.</li> <li>• Serum free media</li> <li>• Balanced salt solutions</li> </ul>                                                                                  |                   |

|                  |                                                                                                                                                                                                           |                   |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>Chapter 5</b> | <b>Primary cell culture</b>                                                                                                                                                                               | <b>4 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Source selection, different methods of establishing primary cell culture</li> <li>• Special reference to fibroblast culture and lymphocyte culture</li> </ul>    |                   |
| <b>Chapter 6</b> | <b>Cell lines</b>                                                                                                                                                                                         | <b>3 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Evolution of cell line</li> <li>• Finite and transformed cell lines</li> <li>• Mammalian and insect cell line growth conditions</li> <li>• Subculture</li> </ul> |                   |
| <b>Chapter 7</b> | <b>Characterization of cell lines</b>                                                                                                                                                                     | <b>2 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Need for characterization</li> <li>• Karyotyping, biochemical &amp; genetic characterization of cell lines.</li> </ul>                                           |                   |
| <b>Chapter 8</b> | <b>Cell storage and distribution</b>                                                                                                                                                                      | <b>2 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Cryopreservation</li> <li>• Cell repositories</li> </ul>                                                                                                         |                   |
| <b>Chapter 9</b> | <b>Applications</b>                                                                                                                                                                                       | <b>2 lectures</b> |
|                  | <ul style="list-style-type: none"> <li>• Applications of Animal cell cultures in different fields</li> </ul>                                                                                              |                   |

## References:

1. Freshney R.I. *Culture of Animal Cells: A Manual of Basic Techniques and Specialized Applications*. 7<sup>th</sup> Edition. Wiley Blackwell; USA: 2015

2. Principles and Practice of Animal Tissue Culture by Sudha Gangal, 2<sup>nd</sup> Edition.
3. Shenoy M 2007 Animal cell culture *Animal Biotechnology* ch 1, p (New Delhi: Firewall)
4. Bhat S.M. *Animal Cell Culture Concept and Application*. Alpha Science International Limited; Oxford: 2011.
5. Walsh G. *Biopharmaceuticals – Biochemistry and Biotechnology*. 2nd ed. John Wiley and Sons; Chichester: 2003
6. Castilho L.R., Moraes A.M., Augusto E.F.P. *Animal Cell Technology*. Taylor & Francis Group; New York: 2008. From Biopharmaceuticals to Gene Therapy.

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**Third Year of B.Sc. Biotechnology**  
**(NEP 2020 under 2024 Pattern)Semester VI**

**Course Code: 24ScBioU6204**

**Course Name: Lab course on 24ScBioU6203**

**Teaching Scheme: TH: 4 Hours/Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem: 30 Marks**

**Prerequisite:**

Basics of Zoology from XI, XII science and F. Y. B. Sc. Biotechnology

**Course Objectives:**

To Study: history, methods, types and applications of animal tissue culture.

To learn how to culture animal cells in artificial conditions and to maintain using subculturing.

| Practical          | Topic                                                                                                                                                                                                                                                                                                                                                               | 15 Practicals      |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Practical 1</b> | <b>ATC laboratory design and equipment used in ATC</b>                                                                                                                                                                                                                                                                                                              | <b>3 Practical</b> |
|                    | <ul style="list-style-type: none"> <li>• Introduction to small-scale ATC lab</li> <li>• Structure and design</li> <li>• Equipment used: Laminar Air Flow, CO2 incubator, Inverted microscope, Autoclave, Filter sterilization assembly, Hemocytometer, Centrifuge, Refrigerator, pH meter, etc.</li> </ul>                                                          |                    |
| <b>Practical 2</b> | <b>Familiarity to Aseptic conditions</b>                                                                                                                                                                                                                                                                                                                            | <b>3 Practical</b> |
|                    | <ul style="list-style-type: none"> <li>• Types of contaminants, identification and measures to be taken.</li> <li>• Importance maintaining aseptic conditions.</li> <li>• Glassware washing, packing and sterilization (Filter sterilization assembly, forceps, glass pipettes, petri plates, beakers, conical flasks etc.)</li> <li>• Media preparation</li> </ul> |                    |

|                    |                                                                                                              |                    |
|--------------------|--------------------------------------------------------------------------------------------------------------|--------------------|
|                    | <ul style="list-style-type: none"> <li>• Sterilization (demo using filter sterilization assembly)</li> </ul> |                    |
| <b>Practical 3</b> | <b>Organ culture / Primary cell culture</b>                                                                  | <b>3 Practical</b> |

|                    |                                                                                                                                                                                                                                     |                    |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|                    | <ul style="list-style-type: none"> <li>• Dissection and separation of organs (heart, liver etc.) from chick embryo (8-9 days old).</li> <li>• Establishment of an organ culture/ Primary culture.</li> <li>• Observation</li> </ul> |                    |
| <b>Practical 4</b> | <b>Maintenance of cell line</b>                                                                                                                                                                                                     | <b>3 Practical</b> |
|                    | <ul style="list-style-type: none"> <li>• Observation of cell line</li> <li>• Media feeding</li> <li>• Sub-culturing: viable cell count, split ratio</li> </ul>                                                                      |                    |
| <b>Practical 5</b> | <b>Geimsa Staining</b>                                                                                                                                                                                                              | <b>2 Practical</b> |
|                    | <ul style="list-style-type: none"> <li>• Geimsa staining of given sample/</li> <li>• Observation of Permanent slide</li> </ul>                                                                                                      |                    |
| <b>Practical 6</b> | <b>Field visit to animal tissue culture facility</b>                                                                                                                                                                                | <b>1 Practical</b> |

References:

1. Principles and Practice of Animal Tissue Culture by Sudha Gangal, 2<sup>nd</sup> Edition.
2. Shenoy M 2007 Animal cell culture *Animal Biotechnology* ch 1, p (New Delhi: Firewall)
3. Bhat S.M. *Animal Cell Culture Concept and Application*. Alpha Science International Limited; Oxford: 2011.

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**Third Year of B.Sc. (Biotechnology)**  
**(NEP 2020 under 2024 Pattern) Semester VI**

**Course Code: 24ScBioU6501**

**Course Name: Lab course on Molecular**

**Diagnostics**

**Teaching Scheme: P: 4 Hours/Week**

**Credit: 2C (2P)**

**Examination Scheme: CIA: 20 Marks**

**End-Sem:30 Marks**

**Prerequisite Courses:**

Basics of Molecular Biology and Genetic Engineering

**Course Objectives:**

To Study DNA analysis techniques from Plant, Animal, Bacterial and viral cells

To perform the techniques for diagnosis of diseases.

| Practical   | Topic                                                                                                                                                                                                        | 15 Practicals |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Practical 1 | Applications of PCR- PCR based microbial typing                                                                                                                                                              | 3 Practicals  |
|             | <ul style="list-style-type: none"><li>Eubacterial identification based on 16 S rRNA sequences-Amplified Ribosomal DNA Restriction analysis (ARDRA)- Culture independent analysis of bacteria- DGGE</li></ul> |               |
| Practical 2 | Molecular Diagnostic Technique for Viral Testing                                                                                                                                                             | 3 Practicals  |
|             | <ul style="list-style-type: none"><li>RT PCR for identification of RNA viruses and DNA viruses.</li></ul>                                                                                                    |               |
| Practical 3 | Genetic testing in Inherited Diseases                                                                                                                                                                        | 3 Practicals  |
|             | <ul style="list-style-type: none"><li>Lymphocyte culture for Prenatal and preconception genetic testing</li></ul>                                                                                            |               |
| Practical 4 | PCR in forensic science-                                                                                                                                                                                     | 3 Practicals  |
|             | <ul style="list-style-type: none"><li>Determination of Paternity- Human identification and sex determination.</li></ul>                                                                                      |               |
| Practical 5 | Cancer Molecular Diagnostics                                                                                                                                                                                 | 3 Practicals  |
|             | <ul style="list-style-type: none"><li>Checking of p53 gene polymorphism for susceptibility to cancer.</li></ul>                                                                                              |               |

**References:**

1. Glick, D. (Ed.). (2009). Methods of biochemical analysis. John Wiley & Sons.

2. Thompson, R. A. (1977). Techniques in clinical immunology. Blackwell Scientific Publications, Osney Mead, Oxford OX2 0EL
3. Chaitanya, K. V. (2013). Cell and Molecular Biology: A Lab Manual. PHI Learning Pvt. Ltd.
4. Karp, A. (1991). Cytological techniques. In Plant Tissue Culture Manual: Supplement 7 (pp. 503-515). Dordrecht: Springer Netherlands.
5. Pevsner, J. (2015). Bioinformatics and functional genomics. John Wiley & Sons.
6. Basu, C. (Ed.). (2015). PCR primer design. New york: Humana Press.

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**Third Year of B.Sc.  
(Biotechnology)**

**(NEP 2020 under 2024 Pattern)  
Semester VI**

**Course Code: 24ScBioU6004**

**Course Name: On Job Training**

**Credit: 4C (4P)**

**Examination Scheme: CIA: 40 Marks**

**End-Sem: 60 Marks**

**Project work, Thesis Submission & presentation**

- On Job Training shall be carried out under the supervision of a qualified teacher in the concerned Department/Research Institute/Industry
- It shall be pursued for a minimum of 120 hours during the final semester.
- The OJT report is to be prepared as per standard scientific research methodology and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the department.
- The assessment (Internal and external) of the OJT will be as per guidelines.

