Semester 5 (Third Year)

Course Type	Course	Coursecode	Course/Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	Major Core Paper 10 (Theory + Practical)	23ScBIOU5101	Microbial Biotechnology(T+P)	2 4	4	40	60	100
	MajorPaper11 (Theory + Practical)	23ScBIOU5102	Bioinformatics(T+ P)	2 4	4	40	60	100
	MajorPaper12 (Theory)	23ScBIOU5103	Protein Biology	2	2	20	30	50
Major Electives	Elective I (Theory+ Practical)	23ScBIOU5201	Environment Ecology and Biodiversity(T+P)	2 4	4	40	60	100
	Elective II (Theory+ Practical)	23ScBIOU5202	Nanotechnology(T+ P)	2 4	4	40	60	100
Minor (4)	Minor Paper IV(Theory +Practical)	23ScBIOU5301	Applied Biotechnology IV (Plant Tissue Culture) (T + P)	4	4	40	60	100
OE(2)	--		--	--	--	--	--	--
VSC (2)	Major Specific Practical III	23ScBIOU5501	Lab Course on Critical analysis of scientific papers and Scientific Writing	4	2	20	30	50
SEC (2)	--		--	--	--	--	--	--
AEC(2),	--		--	--	--	--	--	--
VEC (2)	--		--	--	--	--	--	--
IKS (2)	--		--	--	--	--	--	--
FP/CEP(2)	FP–II	23ScBIOU5002	Field Project II	4	2	20	30	50
Total				32	22	220	330	550

Semester 6 (Third Year)

ourse Type	Course	Course code	Course/Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	MajorPaper13 (Theory + Practical)	23ScBIOU6101	Biophysical and Biochemical Techniques (T + P)	2 4	4	40	60	100
	MajorPaper14 (Theory + Practical)	23ScBIOU6102	RDT(T+P)	2 4	4	40	60	100
	MajorPaper15 (Theory)	23ScBIOU6103	Bio-safety, Bioethics and IPR	2	2	20	30	50
Major Electives	Elective II (Theory + Practical)	23ScBIOU6201	**Food Biotechnology (T + P)**	2 4	4	40	60	100
	Elective II (Theory+ Practical)	23ScBIOU6202	Agricultural Biotechnology (T + P)	2 4	4	40	60	100
Minor (4)	Minor Paper IV (Theory + Practical)	23ScBIOU6301	Applied Biotechnology V (Animal Tissue Culture) (T + P)	2 4	4	40	60	100
OE(2)	--		--	--	--	--	--	--
VSC (2)	--		--	--	--	--	--	--
SEC (2)	--		--	--	--	--	--	--
AEC(2),	--		--	--	--	--	--	--
VEC (2)	--		--	--	--	--	--	--
OJT (4)	OJT	23ScBIOU6004	On job Training	8	4	40	60	100
FP/CEP(2)	--		--	--	--	--	--	--
Total				26	22	220	330	550

OE: Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC: Co-Curricular Courses

IKS: Indian Knowledge System

OJT : On Job Training

FP: Field Project

VSC: Vocational Skill Courses

CEP: Community Engagement Project

SEM V

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Third Year of B.Sc. (Biotechnology)

(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5101 Course Name: Microbial Biotechnology (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week **Credit: 4C (2T+2P)**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

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

Course Objectives:

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

Course Outcomes:

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

Course Contents

Unit	Title	30 lectures
Unit 1	**Microbial Biotechnology**	**2 lectures**
	• Introduction to microbial biotechnology- Evolution of use of microorganisms in fermentation, its scope	
Unit 2	**Introduction to fermentation processes**	**8 lectures**
	• History of fermentation • 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 • Factors affecting the growth of	

	microorganisms (Classification of microorganisms on the basis of their environmental requirements) such as : pH, temperature, oxygen, salt, sugar, moisture • Molecular adaptations to extreme environments.	
Unit 3	**Microbial growth kinetics**	**4 lectures**
	• Batch (Monod's equation), fed-batch, continuous cultures • Yield coefficients: Definition and concept- $Y_{x/s}$, $Y_{p/s}$, $Y_{p/x}$, Y_{ATP}, Respiratory quotient. • Growth in relation to product formation (Growth-linked & Non-growth linked)- Vitamins, Antibiotics, Enzymes	
Unit 4	**Microbial production of enzymes**	**3lectures**
	• Types of enzymes produced by the microorganisms and their uses. • Immobilization of enzymes-Methods, Properties, Applications, Advantages and Disadvantages	
Unit 5	**Novel pathways in Microorganisms**	**3 lectures**
	• Glyoxylate cycle • PHB production • Poly ketides-antibiotics • Propionate fermentation using acrylate pathway and succinate-propionate pathway • Mixed acid and butanediol fermentation	
Unit 6	**Food Microbiology**	**5 lectures**
	• Food as a substrate (Intrinsic and extrinsic factors) • Microbiological spoilages of foods and sources of microorganisms. • Food Preservation: General principles and methods of food preservation, Use of Chemicals (Added and Developed Preservatives) Canning, Radiations, Low and High Temperature • Concept of HACCP (Hazard Analysis and Critical Control Points)	
Unit 7	**Applications of Microorganisms**	**5 lectures**
	• Geo-microbiology-Ore leaching (methods and examples), Microorganisms in extraterrestrial life studies • Biofertilizers and Biopesticides and Microbial plant growth Promoters(gibberellins and IAA) • GMOs-Norms and applications • Microbial Polysaccharide production: Xanthan, Dextran, Alginate, Scleroglucan, Gellan, Pullulan, Curdlan	
	Practicals in Microbial Biotechnology	

Practical	Title	15 Practicals
Practical 1	**Study of Growth curve**	**1 Practical**
	• Growth Curve using semi-log paper and Generation time of Bacteria/Yeast using turbidometry	
Practical 2	**Effect of Environmental factors**	**2 Practical**
	• Effect of Environmental factors on growth of bacteria (pH, Temperature, salt and Sugar)	
Practical 3	**Immobilization**	**1 Practical**
	• Immobilization of whole yeast cells/ enzyme by suitable method and determination of stability of immobilized enzyme.	
Practical4	**Study of Secondary metabolite**	**1 Practical**
	• Production, Recovery (Filtration, Solvent extraction) and estimation (Bioassay) a of Secondary metabolite (Antibiotic)	
Practical 5	**Sterility testing**	**1 Practical**
	• Sterility testing of injectables/autoclave	
Practical 6	**Determination of Minimum inhibitory Concentration (MIC) of antibacterial compound**	**1 Practical**
Practical 7	**Isolation and identification of starter organisms from Idli batter/ Dahi**	**2 Practical**
Practical 8	**Grading of raw milk**	**1 Practical**
	• Grading of raw milk (Dye reduction test, DMC), Determination of efficiency of Pasteurization by quantitative phosphatase test.	
Practical 9	**Assessment of potability of water**	**2 Practical**
	a.Presumptive test b.Confirmed test c.Completed test. d. Eijkman's test e. IMViC tests	
Practical 10	**Isolation and identification (up to Genus level)**	**2 Practical**
	• Isolation and identification (Genus level) of spoilage causing microorganism from spoiled food	

Practical 11	Industrial visit	1 Practical

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1. The Physiology and Biochemistry of Prokaryotes (2nd Ed.), David White (2003).Oxford university Press.
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1. Industrial Microbiology, A. H. Patel, 2nd Edition, Trinity Press.
2. A textbook of Biotechnology, R. C. Dubey, S. Chand and Company.
3. Textbook of Microbiology, Anathnarayan and Panikar, 10th Edition,
4. Modern Food Microbiology, James Jay,6th Edition, Aspen Publication.
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Third Year of B.Sc. (Biotechnology)

(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5102 Course Name: Bioinformatics (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week Credit: 4C (2T+2P)

Examination Scheme: CIA: 40 Marks End-Sem: 60 Marks

Prerequisite:

- Basics of Molecular Biology and Biotechnology

Course Objectives:

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

Course Outcomes:

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

Course Contents

Unit	Title	30 Lectures
Unit1	Introduction to bioinformatics and data generation	2 lectures
	• History of Bioinformatics • What is bioinformatics and its relation with molecular biology	
Unit2	Basic concepts	5 lectures
	• Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray) • Introduction to data types and Source.	

	Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources.	
Unit3	General Introduction of Biological Databases	7 lectures
	• Nucleic acid databases (NCBI, DDBJ, and EMBL). • Protein databases (Primary, Composite, and Secondary). • Specialized Genome databases: (SGD, TIGR, and ACeDB). • Structure databases (CATH, SCOP, and PDBsum) • Databases (GENBANK, Pubmed, PDB)	
Unit4	Data storage and retrieval	6 lectures
	• Flat files, relational, object oriented databases and controlled vocabularies. • File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). • Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. • The challenges of data exchange and integration. • Ontologies, interchange languages and standardization efforts. • General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.	
Unit5	Sequence Alignments and Visualization	8 lectures
	• Introduction to Sequences, alignments and Dynamic Programming; • Local alignment and Global alignment (algorithm and example) • Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm) • Molecular docking • Protein modeling	
Unit6	Introduction to " Omics"	2 lectures
	• Genomics, proteomics and transcriptomics	

B) Practical: (1 credit) (8 practical x 3 Hrs. = 24 Lectures)

Practical	Topic	15 practicals
Practical 1	Introduction to biological databases and retrieving the information – NCBI, EMBL , DDBJ	3 Practicals
Practical 2	protein database – Uniprot database	1 Practical
Practical 3	Literature Database – (PubMed)	1 Practical
Practical 4	Structure databases – PDB SCOP, CATH	3 Practical
Practical 5	Study of File Format (Genbank, DDBJ, FASTA, PDB, SwissProt).	2 Practical
Practical 6	Introduction to metadata and searching of information – Boolean operators (AND, OR , NOT)	2 Practical
Practical 7	Introduction of sequence alignment	2 Practical
	• Introduction to pairwise sequence alignment Use of BLAST and FASTA tools for pairwise sequence alignment.	
Practical 8	Multiple Sequence Analysis- Clustal W	1 Practical

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Third Year of B.Sc. (Biotechnology)

(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5103 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 learnt 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 bimolecular 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:

-

Course Contents

Unit	Topic	30Lectures
Unit1	Introduction to proteins	04 lectures

	• Introduction and functions of protein • Classification of proteins with examples: Simple, complex, Fibrous, Globular. • Overview & properties of amino acids	
Unit 2	**Protein Structure**	**10 lectures**
	• Primary structure of proteins: Peptide bond & its characteristics. • Secondary structure:Alpha helix, Beta sheets,Beta turns,Ramachandran plot,Super secondary structure • Tertiary structure: Keratin structure, • Non covalent interactions that stabilize protein structure. • Quaternary structure: Hemoglobin • Folding &Misfolding of protein	
Unit 3	**Protein Metabolism**	**10 lectures**
	• Degradation –Amino acids degradation, transamination and Urea Cycle. • Amino acid synthesis • Protein turnover.	
Unit 4	**Applications of protein**	**06 lectures**
	• Proteins in Biological system: Lipoproteins, Immunoglobulins, Hormones, Membrane protein. • Proteins in industry • Theraupeutic Hormone & Vaccines Industrial enzymes(Protease/Amylase)	

References:

1. Lehninger Principles of Biochemistry; David L. Nelson, Michael M. Cox; 7th 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; 26th edition; McGraw Hill Professional; [2003].
5. Biochemistry; Rex Montgomery, Thomas W. C, Arthur AS, Barry H. G; 5th edition; St. Louis:

Mosby; [1990].
6. Principles of biochemistry; Donald Voet, Judith Voet, Charlotte Pratt; 5th edition; Hoboken, NJ: Wiley; [2008].
7. Outlines of Biochemistry; E. Conn, P. Stumpf; 4th edition; New York, Wiley; [1976].
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Third Year of B.Sc. (Biotechnology)

(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5201 **Course Name: Environment, Ecology and Biodiversity (T+P)**

Teaching Scheme: TH: 2 Hours / Week **Credit: 4C (2T+2P)**
P: 2 Hours/Week

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses:

- Knowledge of environment and basics of ecosystem Ecology
- Knowledge of plants& animals ecology in India.

Course Objectives:

- To understand Ecology, environment and its measurements
- To Study Biodiversity and Ecosystems.
- To learn Conservation and Laws of Biodiversity.

Course Outcomes:

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

- To make aware of students about environment and prevention measurement of pollution and .changing environmental conditions
- Research in Biodiversity and Environment.
- Field study make a really understand Biodiversity and Hot Spots in India.

Course Contents

	Ecology	
Unit	**Title**	**15 Lectures**
Unit 1	**Understanding Environment and Ecology**	**2 lectures**
	• Introduction to Environmental science and Ecology • Environmental Components- Atmosphere, Hydrosphere, Lithosphere and Biosphere	
Unit 2	**Ecosystem : Principles and its concepts-**	**3 lectures**
	• Introduction. Definition, Characteristics • Components of ecosystem • Types of ecosystem • Aquatic and terrestrial Ecosystems • Homeostasis • Biotic community • Ecotone and edge effect	
Unit 3	**Ecological succession**	**2 lectures**
	• Introduction, Definition ,Types of succession examples of succession • General process of succession • Concept and types of climax	
Unit 4	**Energy Flow**	**2 lectures**
	• Food chain and food web • Trophic Levels • Energy efficiency and Energy Budget • Nutrient cycles (Nitrogen, Phosphorus, and Carbon)	
Unit 5	**Bioremediation**	**2 lectures**
	• Introduction • Types of Bioremediation • Importance of bioremediation • Microbial Biodegradation **(**Plastic, Pesticides/Insecticides and Herbicides, Hydrocarbons)	
Unit 6	**Hazards and Waste Management**	**2 lectures**

	• Hazards in environment • Biomedical waste management • Integrated waste management	
Unit 7	**Current global environmental issues**	**2 lectures**
	• Acid rains causes and effects • Greenhouse Gases, Green House Effect and Global warming • Ozone depletion • Global Climate Change • Impact of global warming in India	
	Biodiversity	**15 Lectures**
Unit 1	**Understanding of Biodiversity**	**4 lectures**
.	• Concept of biodiversity , • Definition , Taxonomic, ecological and genetic perspectives of biodiversity, • Change in Biodiversity over time and space,	
Unit 2	**Ecosystem diversity**	**4 lectures**
	• Species diversity • Genetic diversity • Ecosystem Community Diversity.	
Unit 3	**Biodiversity in Ecosystem**	**3 lectures**
	• Biodiversity in India : Habitats, Niche, Hot spots of biodiversity • Biomes of the world: Animals, plants and micro organism.	
Unit 4	**Population diversity**	**2 lectures**
	• Population density, abundance and richness • Population Structure and interactions	
Unit 5	**Conservation of Biodiversity**	**2 lectures**
	• Need for conservation of biodiversity • Strategies for conservation , • Methods for conservation –*Ex situ* and *In situ*	

	Practical in Ecology	
Practical	**Title**	**Total practical 7**
Practical 1	**Community sampling-By Quadrate method**	**1 Practical**

	• Community sampling-By Quadrate method for plants: Percentage of frequency, density, abundance, frequency class diagram and comparison with Raunkiaers frequency chart, Simpson's index of dominance	
Practical 2	**Study of polluted and unpolluted soil**	**4 Practical**
	• Estimation of Physical properties of polluted and unpolluted soil by Colour and Texture, Water holding capacity • Estimation of Chemical properties of polluted and unpolluted soil: pH and Alkalinity, Organic content	
Practical 3	**Studying pollution indicator plants**	**1 Practical**
	• Studying pollution indicator plants in terms of morphology and anatomy (any 5-7 plants)	
Practical 4	**Genotoxicity**	**1 Practical**
	• Genotoxicity and Cytotoxicity assay to estimate water contamination (Polluted and Non Polluted)	
Practical in Biodiversity		
Practical	**Title**	**Total Practical 8**
Practical 1	**Point count method of biodiversity**	**1 Practical**
	• Point count for bird diversity	
Practical 2	**Quadrate/transact method for analysis richness/diversity**	**2 Practical**
	• Practicals in Quadrate/transact methods for plant diversity analysis	
Practical 3	**Practicals in Field studies for analysis of biotic & abiotic factors**	**2 Practical**
	• Field visit to Forest ecosystem / National Botanical Garden/National Zoological Park/ Biodiversity Park/Visit any Local Garden in Pune / Bird Scanturies • Report on Comparative study between any two fields (e.g. Forest & Botanical garden)	
Practical 4	**Calculation of the field visit data**	**1 Practical**
	• Calculation of species diversity, richness and abundance from the field visit data.	

References:

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2. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata
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8. Environmental Science (2011) Santra S.C. New Central Book Agency, Kolkata

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11. Introduction to Environmental Biotechnology (2007) Chattergy PHI Learning Pvt. Ltd, Delhi

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13. Evans & Furlong. Environmental Biotechnology. Theory& Applications. 2nd ed 2011. Wiley -Blackwell.
14. Scragg A. Environmental Microbiology Oxford Univ Press. 2005.
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1. A Text Book of the plant Geography of India (1983) Bharucha FROUP India .
2. An advanced text book on biodiversity – practices (2004) krishnamurthuy K V Oxford and Publishing , Delhi.
3. Environmental biotechnology (2010) RanaRastogi Publications, Meerut.
4. Environmental science (2011) Santra S.C. New central book agency , Kolkata
5. Fundamental of ecology (2009) Dash 3 rd edition , Tata McGraw-Hill Education, New Delhi.
6. Modern Text Book of Zoology – Vertebrates (2010) Kotpal R E Rastogi Publication, New Delhi.
7. Text Book of Biodiversity (2003) Krishnamurthy K V Science Publishers, Jodhpur.
8. Biological Systematics: Principles And Applications (2002) Randall T. Schuh Cornell University Press, USA

9. Genetic Engineering: Principles And Practice (1996) SandhyaMitra Macmillan Pvt Ltd India, Bangalore

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11. Global Biodiversity Strategies (1992) Courrier Kathleen (Editor) World Resource Institute,USA

12. Introduction To Microbiology (2004) John and Catherin Ingraham Brooks/Cole Pub, USA

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(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5202 **Course Name: Nanotechnology (T+P)**

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week **Credit: 4C (2T+2P)**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses:

- 12^{th} 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–

Course Contents

Unit 1	Nano scale Science and Technology	12 lectures
	• The nanoscale: Science and Technology. • Classification of nanostructured materials	

	• Length scales involved and its effects on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.	
Unit 2	**Preparation methods of Nanoparticles**	**12 lectures**
	• Bottom-up and Top-down approach: Precipitation, Mechanical Milling. • Biological synthesis by bacteria, fungi, plants • Advantage and limitations of biological synthesis	
Unit 3	**Characterization techniques**	**16 lectures**
	• X-ray diffraction technique, • Scanning Electron Microscopy, • Environmental techniques, • Transmission Electron Microscopy including high-resolution imaging, • Confocal microscopy	
Unit 4	**Application of Nanotechnology**	**12 lectures**
	• Nano materials in medicine agriculture and environment • **Environment applications** :Nano remediation, nanopaints and nanofilters,nanocatalysts for degradation of pollutants • **Medical applications**: nanomedicines, antimicrobial agents, nanoparticles in drug delivery, Nanoparticles in cancer treatment andnanonephrology and tissue engineering, • **Agricultural applications**: nanofertilizers, nanopesticides, nanopigments •	
Unit 5	**Impact of nanotechnology**	**8 lectures**
	• Impact of nanotechnology • Ethical issues • Patent issues in nanotechnology • Health and environment ris measurements	

	Practical Based on Nanotechnology	
Practical	**Title**	**15 practicals**
Practical 1	To study the working of UV-Visible spectrophotometer.	**2 Practical**

Practical 2	To study the Absorption spectrum of FeCl3 solution.	**2 Practical**
Practical 3	Synthesis of Silver nanoparticles by using chemical method	**2 Practical**
Practical 4	Synthesis of Silver nanoparticles by using biological method	**3 Practical**
Practical 5	To study the Absorption spectrum of Silver nanoparticles	**2 Practical**
Practical 6	To study the X-ray diffraction pattern.	**3 Practical**
Practical 7	Visit to advance instrument facility.	**1 Practical**

References:

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2. Nanoscale materials -Liz Marzan and Kamat.

3. Physical properties of Carbon Nanotube-R Satio.

4. Polymer nanocomposites: Edited by Yiu-Wing Mai and Zhong-Zhen Yu, First published 2006, Woodhead Publishing Limited and CRC Press LLC, USA.

5. Physics of Magnetism - S. Chikazumi and S.H. Charap.

6. Magnetostriction and Magnetomechanical Effects - E.W. Lee.

7. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.

8. Nanotubes and Nanowires- CNR Rao and AGovindaraj RCS Publishing.

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Third Year of B.Sc. (Biotechnology)
(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5301 Course Name: Applied Biotechnology IV (Plant Tissue Culture) (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week **Credit: 4C (2T+2P)**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses: Knowledge of Plant Science

Course Objectives: To understand Plant tissue culture techniques

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

- Understand the plant tissue culture for production of plants with all desired characters technique and its commercialization.

Course Contents

Unit	Title	30 Lectures
Unit 1	**Concept of Plant Tissue culture**	2 lectures
	• Concepts of Cell theory & Cellular totipotency • Scientists contribution to plant tissue culture	
Unit 2	**Basics Facilities of Plant Tissue culture**	2 lectures
	• Laboratory design of plant tissue culture laboratory – Research and Commercial Lab • General & aseptic laboratory, different work areas, • Principle and Working of equipments & instruments required in PTC .	
Unit 3	**Aseptic Techniques**	2 lectures
	• Washing & preparation of glassware, packing & sterilization: packing & sterilization of Glassware plastic ware and Instruments • Media sterilization and surface sterilization, Unitof energy and pressure • Precautions to maintain aseptic conditionsin PTC Lab	

Unit 4	**Media Preparation**	3 lectures
	• Units for solution preparation • Media Composition: inorganic salt, carbon and energy source organic supplements gelling agents pH • General methodologyfor medium preparation. • Different types media used in PTC • PGRs and their *in vitro* roles for growth and development in PTC	
Unit 5	**Micropropagation**	3 lectures
	• Explant: Used for plant tissue culture • Response of explants *in vitro*– Dedifferentiation and redifferentiation • Different Stages of Micropropagation • Applications of Micropropagation	
Unit 6	**Techniques of Plant tissue culture**	**18 lectures**
a	**Callus culture technique** – • Introduction, Types of callus, Factors affecting, protocol, Morphology & internal structure of callus, Maintenance of callus, Applications and limitations	2
b	**Suspension culture technique** – • Introduction, Types, Culture medium,Protocol,Synchronization,maintenance of cultures. • Assessment of growth measurements and Viability • Applications and limitations	2
c	**Organogenesis** : • Introduction, Types of organogenesis(direct and indirect), Protocol • Factors affecting Organogenesis • Applications and limitations	1
d	**Somatic embryogenesis** • Introduction, types of embryogenesis (direct and indirect), • Stages of somatic embryogenesis. • Induction, development and maturation of SE. • Factors affecting somatic embryogenesis • Advantages and disadvantages	2
e	**Anther and pollen culture** – • Introduction, Pretreatments and Protocol	2

	• Pathways of development • Factors affecting • Advantages and disadvantages	
f	**Organ culture technique** – • Introduction, Protocol, factors affecting w.r.t. • Root tip culture, • Leaf culture, • Shoot tip & • Meristem culture, • Importance of Organ culture	3
g	**Ovary, ovule, embryo and endosperm culture**. • Introduction, Types of culture, Protocol • Factors affecting • Applications and limitations	1
h	**Protoplast –isolation, culture and fusion** • Introduction, Different methods, Protocol • Factors affecting • Applications and limitations	3
i	**Cryopreservation—** • Introduction, Principle, Different methods • Steps of cryopreservation techniques • Factors affecting • Applications and limitations	1
j	• Applications of plant tissue culture in research and commercial Industry	1

Practicals in Plant Tissue culture		
Practical	**Title**	**15 Practical**
Practical 1	**Laboratory Organization**	**1 Practical**
Practical 2	**Lab-ware Preparation for Aseptic transfer**	**1 Practical**
	• Washing of Glass ware/ plastic ware • Glassware preparation for sterilization capping/plugging, packing & sterilization, safety precautions	
Practical 3	**Stock solutions and Media preparation**	**3 Practical**
	• Stock solutions calculations and preparation • Growth hormone calculation and preparation • Calculation for media Preparation • Media preparation	

Practical 4	**Callus culture Technique**	**2 Practical**
	• Callus culture technique - Initiation of culture and callus morphology Explants: leaf disks and wounded explant	
Practical 5	**Cell Suspension Culture**	**3 Practical**
	• Initiation of cell suspension culture • Study of biochemical parameters (Haemocytometer and Packed Cell Volume)	
Practical 5	**Meristem Culture**	**2 Practical**
	• Initiation of shoot tip & axillary bud culture	
Practical 6	**Anther culture**	**1 Practical**
	• Anther and Pollen culture	
Practical 7	**Embryo culture**	**2 Practical**
	• To germinate *in vitro* monocot and dicot embryo	

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)

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

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Third Year of B.Sc. (Biotechnology)
(NEP 2020 under 2023 Pattern) Semester V

Course Code: 23ScBioU5501 **Course Name: Lab course on critical analysis of scientific papers and scientific writing**

Teaching Scheme: P: 4 Hours/Week **Credit: 2C (15 P)**

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

Practical	Title	15Practicals
Practical 1	**Introduction:**	
1	• What is Critical Thinking? • What is Scientific Writing? • Significance • Need • Applications	**1Practical**

Practical 2	**Scientific Communication**	
	• Introduction • Significance • Need • Types (Oral and Written)	**2Practical**
Practical 3	**Forms of Scientific Communication and Publications:**	
	• Case Study • Short Communication • Research Articles • Technical Reports	**1Practical**
Practical 4	**IMRAD format:**	
	• Research and Review Papers, • Project Reports, • Dissertation Report	**2Practical**
Practical 4	**Literature Review - Review Paper or Chapter in Report:**	
	• Process • Significance • Example	**2Practical**
Practical 6	**Result Analysis: Data Analysis and Data Representation:**	**2Practical**
	• Tables • Graphs • Statistical tests	
Practical 7	**Bibliography and Citation Styles:**	
	• Citation Styles • Soft ware for reference management	**1Practical**
Practical 8	**Plagiarism and Ethics in Research:**	
	• Concept and Types of Plagiarism • Soft ware for plagiarism checking • Ethics	**2Practical**
Practical 9	**Journals in Biotechnology:**	**1Practical**
	• How to search a good journal? • Good journal vs. Bad journal • Important links on Journal Website - Instruction to Authors as well as Aim and Scope	
Practical 10	**Power Point Presentation:**	

	• Evaluation of any research	**1Practical**

References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman& Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. 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
5. *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 2023 Pattern) Semester V

Course Code: 23ScBioU5002 **Course Name: Field Project**

Teaching Scheme: P: 4 Hours/Week **Credit: 2C**

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

Field Project work, Report Submission & presentation

SEM VI

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Third Year of B.Sc. (Biotechnology)
(NEP 2020 under 2023 Pattern) Semester VI

Course Code: 23ScBioU6101 Course Name: Biophysical and Biochemical Techniques (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week **Credit: 4C (2T+2P)**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 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 thePrinciple, 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 understand the basic concepts involved in basic biochemical techniques. It will prepare studentsin the field of life sciences, biochemistry and research.

Course Contents

Units	Title	30 Lectures
Unit1	Centrifugation	7 Lectures
	• Introduction • Basic principles of sedimentation :Centrifugal Force, R and g concept and difference • Problems based on R and g conversion	

	• Basic Instrumentation • Rotors and its types • Types of centrifugation: Principle and working of Differential Centrifugation, Density Gradient Centrifugation • Preparative centrifugation, Analytical centrifugation • Care and maintenance of centrifuge	
Unit 2	**Solutionsand Buffers**	**6 Lectures**
	• Standard solution and Standard Substance • Concentration of solutions • Strong acids and bases, weak acids and bases • Biochemical importance of weak electrolytes • Buffers: Definition, solutions preparation • Buffer capacity, Selection of a buffer • Biological Buffer: definition, example and Significance	
Unit 3	**Advanced microscopy and spectroscopy**	**8 Lectures**
	• Light concept and Refractive Index • Electromagnetic radiations: dual nature and properties. • Definition and concept of wavelength, frequency, Energy Levels in Atoms & Molecules • Introduction to microscopy: Basic microscope parts and their working • Preparation of specimens for different types of microscopy • Phase contrast microscopy • Fluorescence microscopy • Electron Microscopy • Atomic Force Microscopy • Colorimeter and UV-visible spectrophotometer	
Unit 4	**Advanced Separation Techniques**	**9 Lectures**
	• General principle of Electrophoresis • Agarose gel electrophoresis of DNA • Native and SDS PAGE, Isoelectric focusing	

	• Pulsed-field gel electrophoresis, Capillary electrophoresis • Definition and conceptof chromatography, • Thin layer chromatography, Paper chromatography • Column chromatography –Size exclusion chromatography, Ion-exchange(Principle, working and applications of each), Affinity chromatography (Concept) • Advanced chromatography Techniques: Introduction to HPLC and GC	

Practicals	Title	No. of Practicals
Practical 1	**Buffer Preparation**	**2**
	• To study preparation of buffer of given pH by preparing given percentage, molar and normal solutions.	
Practical 2	**Colorimetry**	**2**
	• To study Beer-Lambert's law and to determine relationship between absorbance and concentration using standard graph method.	
Practical 3	**Density Gradient Centrifugation**	**2**
	• Purification of the given sample (protein/enzyme/other) by using sucrose density gradient centrifugation	
Practical 4	**Statistical Analysis**	**2**
	• To solve problems based on T test.	
Practical 5	**Electrophoresis & Activity Staining**	**3**
	• To perform Native gel electrophoresis for activity staining.	
Practical 6	**Fluorescence observation**	**2**
	• To observe the fluorescence of the given sample	
Practical 7	**Estimation of Ascorbic acid**	**2**

	• To estimate ascorbic acid in given sample by volumetric method.	

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
6. Biophysics. Firstedition (2002. Pattabhi V, Gautham N. Kluwer Academic Publisher, USA.
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Third Year of B.Sc. (Biotechnology)
(NEP 2020 under 2023 Pattern) Semester VI

Course Code: 23ScBioU6102 Course Name: Recombinant DNA Technology (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week Credit: 4C (2T+2P)

Examination Scheme: CIA: 40 Marks End-Sem: 60 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 inGenetic engineering.
- To learn the progress in the field of Recombinant DNA technology.

Course Outcomes:

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

- Gain a sufficient knowledge to manipulate a gene / DNA for obtaining the desired product.

Course Contents

Unit	Title	30 Lectures
Unit 1	**Introduction to Recombinant DNA Technology**	**2 Lectures**
	• Historical perspective • Overview of Recombinant DNA Technology • Ethics and Biosafety in recombinant DNA technology	
Unit 2	**Molecular tools used in Recombinant DNA Technology**	**4 Lectures**
	• Different enzymes – Restriction enzymes, Ligases, Polymerases, Alkaline Phosphatases, Nucleases, Transferases • Introduction to PCR technology: Steps in PCR, Factors affecting PCR, Applications of PCR	
Unit 3	**Vectors used in Recombinant DNA Technology**	**8 Lectures**
	• Plasmids • Bacteriophages: λ and M13 • Expression vectors: pET Vector • Agrobacterial Vectors – pTi plasmid • YAC, BAC • Chimeric Vectors - ➢ Cosmids: Single Cos cosmids and Dual coscosmids ➢ Phasmids: λZAP series ➢ Phagemids: pGEMZf series, pEMBL8 ➢ Fosmids: pFOS1	
Unit 4	**Transformationand Transfection**	**3 Lectures**
	• Methods of introduction of DNA into: Bacterial cell, Animal cell and Plant cell. • Selection and Characterization of transformants	
Unit 5	**Purification of DNA from living cells and yield**	**2 Lectures**

	analysis	
	• Purification of Total cellular / chromosomal DNA and its characterization • Purification of Plasmid DNA – Plasmid Characterization • Purification of Bacteriophage DNA and its characterization	
Unit 6	**Sequencing of Genes and Genomes**	**2 Lectures**
	• Maxam Gilbert's method • Sanger's Manual method • Automated DNA sequencing	
Unit 7	**Genome Mapping**	**3 Lectures**
	• Techniques of Genome mapping: Physical and Genetic • DNA Fingerprinting	
Unit8	**Construction of Genomic and cDNA Library**	**2 Lectures**
	• Process of library construction • Comparison between Genomic and cDNA library	
Unit9	**Applications of Recombinant DNA Technology and Guidelines to create genetically modified organisms**	**4 Lectures**
	• Application in Agriculture • Application in Food Industry • Application in healthcare and Pharmaceutical industry	

Practical	**Title**	**Total practicals 15**
Practical 1	**Genomic DNA Isolation and its characterization (Qualitative / Quantitative)** • Isolation of Animal DNA	**2**
Practical 2	• Isolation of Plant DNA	**2**
Practical 3	• Isolation of Bacterial Chromosomal DNA	**2**
Practical4	**Plasmid DNA Isolation and Gel Electrophoresis**	**1**
Practical 5	**Restriction Digestion of the DNA sample, ligation and Gel electrophoresis**	**4**
Practical6	**Transformation of *E. coli* Cells:**	**2**
	• Preparation of Competent Cells • Transformation technique • Selection of Recombinants	
Practical 7	**PCR Amplification of DNA and Gel Electrophoresis**	**2**

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 andTwyman, Blackwell Publishing, USA.
4. Molecular Biology of the Gene, 7th Edition (2013), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education, Inc.
5. 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 2023 Pattern) Semester VI

Course Code: 23ScBioU6103 **Course Name: Bio-safety, bioethics and IPR**

Teaching Scheme: TH: 2 Hours / Week

Credit: 2C (2T)

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

Prerequisite:

This is an advance level course. Students must have an understanding of introductory undergraduate level course such as chemistry, biology, microbiology, plant and animal biology and molecular biology

Course Objectives:

- To make students learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products.
- The biotechnology students supposed to understand and follow the regulatory framework important for the product safety and benefit for the society.

- The students are given case history to discuss and express their views.

Course Outcomes:

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

- At the end of the course, it is expected that students have understood the basic issues of Biosafety & Bioethics.
- IT is expected that they will be more confidant to practice and implement all these policies in their future endeavor

Course Contents

Unit	Title	Lectures
	A) Biosafety	**20 Lectures**
Unit 1	**Introduction to Biosafety**	**2 Lectures**
	• Introduction to Biosafety Practices • Safety Checklist: Storage facilities, Ventilation, Laboratory safety, Biosecurity, Personnel protection.	
Unit 2	**General lab safety**	**6 Lectures**
	• Lab design & facilities, equipment Safety • Hazardous Chemicals: Routes of exposure, Storage of chemicals, Toxic effect of chemicals, Explosive etc. • Additional laboratory hazards: Fire hazards, Electrical Hazards, Ionizing radiation, Personnel protection, Infectious materials etc. • Standard precautions for Handling of Radioactive compounds, Acids, Mutagenic agent etc.	
Unit 3	**Good laboratory Practices**	**6 Lectures**
	• Good Microbiological Technique: Safe handling, Use of Biological safety Cabinets, Storage of Infectious material, Precautions of use of blood samples, tissue etc. • Emergency procedure • Disinfection &Sterilization • Transport of biological specimens, • Biological waste management	
Unit 4	**Biological safety**	**6 Lectures**

	• Biological safety cabinets: I,II,III • Biosafety Levels: BSL 1,2,3,4 • Animal Biosafety level: Biosafety Level 1,2,3,4 • Risk assessments for genetically modified organisms and transgenic plants • Biosafety regulations and national and international guidelines with regard to recombinant DNA technology. • Guidelines for research in transgenic plants and animals	
	B) Bioethics	**10 Lectures**
Unit 5	**Introduction to Bioethics**	**6 lectures**
	• History and Introduction • Principles of bioethics: Legality, morality andethics, human rights, privacy, justice, equity etc. • Bioethics: ethical dimensions of IPR, technology transfer and other global biotech issues. • The legal, institutional and socioeconomic impacts of biotechnology; Biotechnology and social responsibility	
Unit 6	**Biotechnology and Ethics**	**4 lectures**
	• Ethics in Human genome project • biopiracy, biowarfare • Animal cloning & human cloning • Ethics in Humans: a. Artificial insemination b. In vitro fertilization & Embryo transplants c. Surrogacy d. Organ Transplants e. Euthensia f. Gene therapy g. Eugenics h. Stem cell therapy • Public education of producing transgenic organism.	

References:

1. Biotechnology and Safety Assessment Thomas J.A., Fuch R.L Academic Press 3rd Edition 2002
2. Biological safety Principles and practices Fleming D.A., Hunt D. ASM Press 3rd. ed. 2000
3. Bioethics Ben Mepham Oxford University Press 2008
4. Bioethics & Biosafety R Rallapalli&Geetha Bali APH Publication 2007
5. Bioethics, second edition, Nancy S.Jecker , Albert R.Jonsen,Robert

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Third Year of B.Sc. (Biotechnology)
(NEP 2020 under 2023 Pattern) Semester VI

Course Code: 23ScBioU6201 Course Name: Food Biotechnology (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week Credit: 4C (2T+2P)

Examination Scheme: CIA: 40 Marks End-Sem: 60 Marks

Prerequisite Courses:

- Knowledge of food science up to 12^{th} std.

Course Objectives:

1. To provide knowledge about techniques used in plant, animal and microbial biotechnology
2. To introduce students to new developments in the field of food biotechnology

Course Outcomes:

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

- To understand the role of biotechnology in Food processing and preservation

Course Contents

Unit	Title	
Unit 1	**Introduction to Food Biotechnology**	**10 Lectures**
	• Introduction to food science and biotechnology • 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), • Minor constituents affecting texture, color, taste, odor of food • Food microbiology, Food biochemistry, Food additives, General food composition and effect of food constituents on food quality.	
Unit 2	**Introduction to Standards for food analysis with suitable example**	**10 Lectures**
	• Standards for food analysis Standards of identity, purity, and methodology for analysis of • Cereals, • legumes, • oil seeds and their products; • Fruits, vegetables, tubers, and their products; • Tea, coffee, cocoa, chocolate, spices, sugar, condiments • Milk and milk products • Meat, fish and poultry products; • Miscellaneous foods e.g., fermented products.	
Unit 3	**Food processing and preservation with suitable example**	**10 Lectures**
	• 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. • 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/ syruping, pickling, fermentation etc., non- thermal processes like MAP, irradiation, high pressure processing etc., and hurdle technology	

Practical	Title	Total practicals 15
Practical 1	• Analysis of milk (liquid) & detection of adulterants in milk	**2**
Practical 2	• Analysis of grain flour and determination of damaged starch	**2**
Practical 3	Analysis of tea and coffee	**2**
Practical4	Analysis of alcoholic beverages	**1**
Practical 5	Estimation of food bioactives (phenolics, pigments etc)	**2**
Practical6	Detection of Food adulteration	**2**
Practical 7	Fruit and vegetable processing: Dehydration and Product Development	**1**
Practical 8	Milk processing: Development of dairy product	**2**
Practical 9	Visit to food industry	**1**

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. 2nd ed. Van Nostrand Reinhold, NY
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Third Year of B.Sc. (Biotechnology)

(NEP 2020 under 2023 Pattern) Semester VI

Course Code: 23ScBioU6202 Course Name: Agricultural Biotechnology (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week **Credit: 2C (2T+2P)**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 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 theAgri based Industries

Course Outcomes:

- On completion of the course, students will be able to get placements in Agro-and Cottage industries, Seed/Sapling production units, Pesticide-insecticide production units, Post-harvest processing firms, Agri-finance institutions, etc.

Course Contents

Unit	Topics	30 Lectures
Unit 1	**Introduction to Agriculture**	**7 Lectures**
	• Agriculture and its scope, Crop nutrition, and fertilizers, • Water resources,soil-plant-water relationship • Crop rotation and its principles, crop management technologies.	
Unit 2	**Organic Farming**	**6 Lectures**
	• Principles and scope of organic farming in India • Choice of crops and varieties in organic farming • Contract Farming: concept and scope	
Unit 3	**Soil Science**	**5 Lectures**
	• Soil as a natural body, soil forming, rocks and minerals, Soil Profile, Components of soil • Soil: taxonomy, classification and types of soils in India	
Unit 4	**Conventional and Hi-Tech Agriculture**	**6 Lectures**
	• Conventional Plant propagation-methods and propagating structures • Importance and advantages of hi tech propagation, Site selection, irrigation system , irrigation system Maintenances of Poly house,	
Unit 5	**Mushroom Cultivation**	**6 Lectures**
	• A study on morphology of mushroom	

	• Introduction to mushroom types • Cultivation of mushrooms examples Oyster mushroom (*Pleurotus spp*.), • Harvesting and preservation of mushrooms	

Practicals

Unit	Topics	Practical
Unit 1	**Anemometer, Rain Gauge**	**5 Practical**
	• To record temperature, wind speed, and rain fall of the atmosphere. • To determine the biomass of a particular area. • To estimate the available nutrient status, reaction (acidity/alkaline) of a soil.	
Unit 2	**Soil Testing**	**4 Practical**
	• To determine and compare the humus contents of polluted and unpolluted soils • To test the presence of phosphate , Sulphate , and Chloride in the soil • To measure the temperature of soil and air • To measure humidity and light intensity	
Unit 3	**Mushroom Cultivation**	**3 Practical**
	• To determine the presence of carbonates in the given soil sample • A study of mushroom morphology • Preparation of spawn	
Unit 4	**Polyhouse technology**	**3 Practical**
	• Cultivation of Oyster mushroom (Pleurotus spp.) • Importance of Polyhouse • Field Visit	

References:

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

2. Plant pigments and their manipulation – Annual plant revies, 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).

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7. Fungal Biotechnology (IK International); Rai M (2009).

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(NEP 2020 under 2023 Pattern) Semester VI

Course Code: 23ScBioU6301 Course Name: Applied Biotechnology V (Animal Tissue Culture) (T+P)

Teaching Scheme: TH: 2 Hours / Week

P: 4 Hours/Week Credit: 4C (2T+2P)

Examination Scheme: CIA: 40 Marks **End-Sem: 60 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–

- Understand the basic concepts related to culturing of animaland insect cells in artificial conditions.
- Understand concepts related to history, methods, types &applicationsof animal tissue culture.

Course Contents

Chapter	Title	Lectures
Chapter 1	**Introduction and history**	**2 lecture**
	• History of animal cell culture • Comparison with bacterial culture • *In vivo* v/s *in vitro* growth conditions for cells of multicellular organisms	
Chapter 2	**Basic concepts of ATC**	**3 lectures**
	• Concept of monolayer, suspension, histotypic/ organotypic, organ culture • Maintenance of aseptic conditions. • Contamination, types of contaminants • Cross contamination • Disposal practices used in ATC lab	
Chapter 3	**Equipment and infrastructure**	**6 lectures**
	• Laboratory design • Instruments used in ATC • Labware: TC flasks	
Chapter 4	**Nutrition & Physiology**	**6 lectures**
	• Rationale behind medium formulation with examples • Advantages and disadvantages of serum. Serum free media • Balanced salt solutions	

Chapter 5	Primary cell culture	4 lectures
	• Source selection, different methods of establishing primary cell culture • Special reference to fibroblast culture and lymphocyte culture	
Chapter 6	**Cell lines**	**3 lectures**
	• Evolution of cell line • Finite and transformed cell lines • Mammalian and insect cell line growth conditions • Subculture	
Chapter 7	**Characterization of cell lines**	**2 lectures**
	• Need for characterization • Karyotyping, biochemical & genetic characterization of cell lines.	
Chapter 8	**Cell storage and distribution**	**2 lectures**
	• Cryopreservation • Cell repositories	
Chapter 9	**Applications**	**2 lectures**
	• Applications of Animal cell cultures in different fields	

	Practicals in Animal Tissue Culture	
Practical	**Title**	**Total Practicals 15**
Practical 1	**ATC laboratory design and equipment used in ATC**	**3 Practical**
	• Introduction to small-scale ATC lab • Structure and design • Equipment used: Laminar Air Flow, CO_2 incubator, Inverted microscope, Autoclave, Filter sterilization assembly, Hemocytometer, Centrifuge, Refrigerator, pH meter,etc.	
Practical 2	**Familiarity to Aseptic conditions**	**3 Practical**
	• Types of contaminants, identification and measures to be taken. • Importance maintaining aseptic conditions. • Glassware washing, packing and sterilization (Filter sterilization assembly, forceps, glass pipettes, petri plates, beakers, conical flasks etc.) • Media preparation	

	• Sterilization (demo using filter sterilization assembly)	
Practical 3	**Organ culture / Primary cell culture**	**3 Practical**
	• Dissection and separation of organs (heart, liver etc.) from chick embryo (8-9 days old). • Establishment of an organ culture/ Primary culture. • Observation	
Practical 4	**Maintenance of cell line**	**3 Practical**
	• Observation of cell line • Media feeding • Sub-culturing: viable cell count, split ratio	
Practical 5	**Geimsa Staining**	**2 Practical**
	• Geimsa staining of given sample/ • Observation of Permanent slide	
Practical 6	**Field visit to animal tissue culture facility**	**1 Practical**

References:

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