TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 1st Sem.
Course Title: Chemistry of Biomolecules	**Subject Code:** TIU-PBT-T125
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understanding the Chemical Properties of Biomolecules – Explore the fundamental chemical concepts such as water as a universal solvent, pH, buffers, and osmotic processes, and their importance in maintaining biological homeostasis.
2. Study of Cell Membrane Structure and Function – Develop a deep understanding of the fluid mosaic model, membrane fluidity, and membrane transport mechanisms, and their roles in cellular communication and function.
3. Exploring the Structure-Function Relationship of Biomolecules – Investigate the structural and functional properties of carbohydrates, proteins, lipids, nucleic acids, as well as vitamins, hormones, hemoglobin, myoglobin, and chlorophyll, with an emphasis on their biological significance and role in metabolism and disease.

COURSE OUTCOME:

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

CO-1:	Recollect and describe the role of water as a universal solvent and explain concepts such as pH, buffer systems, and osmosis in the context of biological systems.	K1
CO-2:	Explain and interpret the Fluid Mosaic Model of cell membranes, discuss membrane fluidity, and apply knowledge of membrane transport mechanisms to understand cellular functions.	K2
CO-3:	Analyze the structure and function of biomolecules (carbohydrates, proteins, fats, nucleic acids, vitamins, and hormones), with a focus on hemoglobin, myoglobin, and chlorophyll.	K3

CO-4:	Evaluate the role of antioxidants and redox signaling in cellular health, and examine oxidative stress-related diseases and the potential benefits of medicinal foods in combating these conditions.	K4
CO-5:	Classify the types of biomolecules (carbohydrates, proteins, fats, nucleic acids) and relate their structure to their biological functions in cellular metabolism.	K2
CO-6:	Assess the biochemical mechanisms of membrane transport and analyze the impact of environmental conditions on the fluidity and function of cell membranes.	K3

COURSE CONTENT:

MODULE 1:		**15 Hours**
Water as universal solvent, pH, Buffer, Blood Buffer, colloidal solution, osmosis and its Maintenance, Solution (Normality, Molarity etc.).		
MODULE 2:		**10 Hours**
Cell membrane (Fluid Mosaic Model, Membrane Fluidity), Membrane Transport.		
MODULE 3:		**10 Hours**
Structural and Functional details of: Carbohydrate, Protein, Fat, Nucleic Acid, Vitamins and Hormones. Structure and function: Hemoglobin, Myoglobin, Chlorophyll.		
MODULE 4:		**10 Hours**
Antioxidant and Redox Signaling, Oxidative stress related disease, Medicinal foods.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st**Yr., 1st Sem.
Course Title: Molecular Genetics	**Subject Code:** TIU-PBT-T121
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Understanding DNA Replication, Repair, and Recombination Mechanisms – Gain knowledge of the molecular processes involved in DNA replication, repair, and recombination, including the roles of various enzymes, extrachromosomal replicons, and mechanisms ensuring fidelity of replication.
- Explore RNA Synthesis, Processing, and Function – Develop a comprehensive understanding of RNA transcription, processing, and editing mechanisms, including the formation of initiation complexes, transcription activators, and regulatory factors involved in RNA splicing, polyadenylation, and transport.
- Gene Expression Regulation and Cellular Organization – Investigate the regulation of gene expression at both the transcriptional and translational levels in prokaryotic and eukaryotic systems, as well as the structure and function of intracellular organelles, including the role of chromatin in gene silencing and the molecular organization of genes, chromosomes, and transposons.

COURSE OUTCOME:

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

CO-1:	Describe the key concepts of DNA replication, including the enzymes involved, replication origin, and replication fork, and the mechanisms ensuring replication fidelity and DNA repair.	K1
CO-2:	Explain the process of RNA synthesis and processing, including the formation of the transcription initiation complex, RNA splicing, polyadenylation, and RNA transport mechanisms.	K2
CO-3:	Analyze the process of protein synthesis, including the formation of the initiation complex, translational proof-reading, post-translational modifications, and the roles of tRNA, ribosomes, and translational inhibitors.	K3

CO-4:	Analyze the regulation of gene expression at the transcriptional and translational levels in prokaryotic and eukaryotic organisms, including the role of chromatin structure in gene silencing and regulation.	K3
CO-5:	Describe the structure and function of various intracellular organelles such as the nucleus, mitochondria, Golgi bodies, endoplasmic reticulum, and cytoskeleton, and their roles in cellular processes like motility and metabolism.	K2
CO-6:	Evaluate the organization and structure of genes and chromosomes, including the roles of operons, gene families, heterochromatin, euchromatin, and transposons in genetic expression and regulation.	K4

COURSE CONTENT:

MODULE 1:	**DNA replication, repair and recombination:**	**15 Hours**
DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, and DNA damage and repair mechanisms. **RNA synthesis** a**nd processing:** Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport. **Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyltRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.		
MODULE 2:	**Control of gene expression at transcription and translation level:**	**10 Hours**
Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.		
MODULE 3:	**Structural organization and function of intracellular organelles:**	**10 Hours**
Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.		
MODULE 4:	**Organization of genes and chromosomes:**	**10 Hours**
Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons		

TOTAL LECTURES	45 Hours

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester:** 1st Yr.,1st Sem.
Course Title: Environmental Science	**Subject Code:** TIU-PBT-T117
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Explore biodegradation and bioremediation processes, focusing on the biodegradation of pollutants like hydrocarbons, pesticides, and synthetic dyes using microorganisms and enzymes involved in biotransformation.
- Understand the sources and control of water pollution, emphasizing water management practices, wastewater treatment processes (aerobic and anaerobic), and the microbiological aspects of wastewater treatments. Explore methods for solid waste management, including composting, wormiculture, and biomass-based energy production from agro-wastes.
- Understand the importance of biodiversity and its conservation using biotechnological methods, such as cryopreservation and micropropagation, and study biosafety practices, including the regulation of GMOs and LMOs.

COURSE OUTCOME:

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

CO-1:	Students will be able to define the various types of environmental pollution, methods for its measurement, and explain biodegradation and bioremediation processes, with a focus on microorganisms involved in the degradation of pollutants like hydrocarbons, pesticides, and synthetic dyes.	K1

CO-2:	Students will explain the sources of water pollution, the need for water management, and describe various wastewater treatment processes, including aerobic and anaerobic methods used in industries such as dairy, distillery, and sugar industries.	K2
CO-3:	Students will be able to analyze global environmental issues such as ozone depletion, acid rain, and the greenhouse effect, and evaluate biotechnological methods of biodiversity conservation, including cryopreservation and micropropagation.	K3
CO-4:	Students will evaluate the biotechnological approaches for managing environmental issues, including biodegradation of pollutants, bioremediation, and the use of biotransformation reactions in the environment.	K4
CO-5:	Students will apply the knowledge of Indian and international environmental laws to understand biosafety guidelines for GMOs and LMOs, and recognize the importance of biosafety levels and the role of regulatory bodies like RCGM and GEAC in environmental safety.	K3
CO-6:	Students will be able to interpret the principles of environmental monitoring, use bioindicators for monitoring environmental quality, and assess environmental impacts using tools such as GIS and remote sensing.	K4

COURSE CONTENT:

MODULE 1:	Environment-	**15 Hours**
Environment- Basic concepts and issues; Environmental pollution: types of pollution, measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations. Biodegradation: Biodegradation of pollutants by microorganisms: Persistent organic pollutants; non biological degradation of pollutants: Decay behaviour& degradative plasmids; Hydrocarbons, Substituted hydrocarbons, Oil pollution, Surfactant. Bioremediation: definition; types; notable examples; Xenobiotics in environment: Biodegradation of Hydrocarbons; Substituted hydrocarbons; Surfactant; Pesticides; Lignin; Tannin; Synthetic dyes; Biotransformation: Oxidation reactions: Cytochrome P450 monooxygenase system; Alcohol and aldehyde dehydrogenases; Peroxidases. Reduction reactions: Cytochrome P450 and flavin dependent reactions. Hydrolysis reactions: Carboxyl esterases. Conjugation reactions: Gluthione S transferases. Regulation of biotransformation		
MODULE 2:	Water pollution and its control	**10 Hours**

Water as a scarce natural resource; Need for water management; Measurement of water pollution; Sources of water pollution; Wastewater collection; Wastewater treatment-physical, chemical and biological treatment processes, Microbiology of waste water treatments; Aerobic processes: Activated sludge, Oxidation ditches, Trickling filter, Towers, Rotating discs, Rotating drums, Oxidation ponds; Anaerobic processes: Anaerobic processes; Anaerobic digestion, Anaerobic filters, Upflow anaerobic sludge blanket reactors; Treatment schemes for wastewaters of dairy, distillary, sugar, antibiotic industries. Solid wastes; Sources and management: composting, wormiculture and methane production, Food, feed and energy from solid waste (biomass and agrowastes)

MODULE 3:	Global Environmental Problems	**10 Hours**

Global Environmental Problems: Ozone depletion, UV-B and greenhouse effect, Acid rain, its impact and biotechnological approaches for management. Biodiversity and biotechnology: Classification and quantification of biodiversity; Value; loss and conservation of Biodiversity. Biotechnological methods of conservation: Crypreservation and micropropogation. Environmental Monitoring and Impact Assessment: Biological monitoring program; bioindicators, Environmental Audit: Introduction; Types; General Methodology; Environmental Laws: Problems in making and implementing environmental laws; Indian environmental laws; national environmental policy (draft) 2004; GIS and remote sensing

MODULE 4:	**Biosafety**	**10 Hours**

Biosafety: Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena . **Environmental Problems:** Ozone depletion, UV-B and greenhouse effect, Acid rain, its impact and biotechnological, and approaches for management. **Biodiversity and biotechnology:** Classification and quantification of biodiversity; Value; loss and conservation of Biodiversity. Biotechnological methods of conservation: Cryopreservation and micropropogation. **Environmental Monitoring and Impact Assessment:** Biological monitoring program; bioindicators, Environmental Audit: Introduction; Types; General Methodology; Environmental Laws: Problems in making and implementing environmental laws; Indian environmental laws; national environmental policy (draft) 2004; GIS and remote sensing

TOTAL LECTURES	**45 Hours**

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Cell biology and Signaling	**Subject Code:** TIU-PBT-T115
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Gain an in-depth understanding of the **membrane structure, membrane proteins, and mechanisms of intracellular transport.** Explore the structure and function of key **intracellular organelles** (nucleus, mitochondria, Golgi bodies, etc.), and examine the role of the **cytoskeleton** in cellular motility.
- Develop knowledge of the **cell cycle regulation,** including **mitosis, meiosis**, and their control mechanisms. Understand **cell signaling pathways,** including **hormonal regulation**, **G-protein coupled receptors, second messengers,** and the mechanisms involved in **signal transduction and bacterial/plant signaling systems**.
- Study the principles of **cell communication, cell adhesion**, and their roles in **neurotransmission**. Understand the molecular mechanisms of **oncogenesis, cancer cell biology,** and **the interaction of cancer cells with normal cells,** and explore **therapeutic interventions for uncontrolled cell growth.**
-

COURSE OUTCOME:

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

CO-1:	Retrieve the structure and function of cellular membranes and intracellular organelles, including the lipid bilayer, membrane proteins, ion channels, and active transport mechanisms in relation to cellular processes.	K1
CO-:	Explain the mechanisms of membrane transport, including osmosis, ion pumps, and the regulation of intracellular transport, as well as the role of cytoskeleton in cellular motility and organelle function.	K3
CO-3:	Analyze the steps of the cell cycle, including mitosis and meiosis, and evaluate their regulation, focusing on the control mechanisms and key regulatory proteins involved in cell cycle progression.	K2
CO-4:	Describe the mechanisms of cell signaling, including the signaling pathways through G-protein coupled receptors, second messengers, and the regulation of signaling pathways in cellular communication.	K3
CO-5:	Apply knowledge of bacterial and plant two-component signaling systems, including chemotaxis, quorum sensing, and their biological significance in cellular interactions.	K3
CO-6:	Evaluate the principles of cellular communication, including cell adhesion, extracellular matrix, neurotransmission, and their roles in cancer biology, focusing on oncogenes, tumor suppressor genes, apoptosis, and therapeutic interventions in cancer treatment.	K4

COURSE CONTENT:

MODULE 1:	**Membrane structure and function**	**15 Hours**
Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. **Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.		
MODULE 2:	**Cell division and cell cycle**	**15 Hours**
Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. **Cell signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.		
MODULE 3:	**Cellular communication:**	**15 Hours**

General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. **Cancer:** Oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.	
TOTAL LECTURES	**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st**Yr., 1st Sem.
Course Title: Analytical Biochemistry Lab	**Subject Code:** TIU-PBT-L125
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

- To familiarize students with the concepts and practical applications of solution concentrations, including normality, molarity, molality, and percentage solutions, and to enable them to perform conversions between these different units accurately in laboratory settings.
- To provide hands-on experience in the operation of essential laboratory instruments, such as the pH meter for buffer preparation and pH measurements, and the spectrophotometer for measuring absorption maxima, fostering skills in basic biochemical analysis.
- To train students in the use of chromatographic techniques such as paper chromatography and thin-layer chromatography (TLC) for the separation of amino acids, and to develop their ability to estimate concentrations of biomolecules like nucleic acids, proteins, carbohydrates, and fats through biochemical assays.

COURSE OUTCOME

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

CO-1:	Students will be able to define and convert between different concentrations of solutions such as normality, molarity, molality, and percentage solutions, demonstrating their understanding of solution preparation and concentration calculations.	K1
CO-2:	Students will demonstrate how to operate a pH meter and perform pH measurements of various buffers, developing skills to determine the pH of different solutions and prepare buffers effectively.	K2
CO-3:	Students will determine the isoelectric point (pI) of various amino acids, interpreting the results to understand the relationship between pH and the charge of amino acids.	K3
CO-4:	Analyze absorption maxima using a spectrophotometer	K3
CO-5:	Students will estimate the concentration of biomolecules including nucleic acids, proteins, carbohydrates, and fats using appropriate analytical methods, applying quantitative techniques to assess molecular quantities.	K4
CO-6:	Separate amino acids using paper chromatography and thin-layer chromatography (TLC).	K4

COURSE CONTENT:

Experiment Number	Title	Duration
1	Concept of Normality, Molarity, Molality, Percentage solutions and their inter-conversion	**60 Hours**
2	Operation of pH meter and pHing buffers	
3	Isoelectric point determination of amino acids	
4	Introduction to spectrophotometer, absorption maxima, chromatography.	
5	Estimation of nucleic acids, amino acids, proteins, carbohydrates and fats	
6	Separation of amino acids by Paper chromatography and TLC	
7	Review and assessment	

TECHNO INDIA UNIVERSITY
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Department of Biotechnology

Program: M.Sc in biotech	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Molecular Techniques Lab	**Subject Code:** TIU-PBT-L121
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

- To enable students to master the fundamental techniques for DNA isolation from various sources, including genomic DNA isolation from bacteria, plants, and animal cells, ensuring proficiency in handling biological samples and applying molecular techniques.
- To provide practical experience in plasmid DNA isolation from bacterial cultures, allowing students to understand the differences between plasmid and genomic DNA and the importance of plasmid purification in molecular cloning and other applications.

  To develop skills in the analysis of DNA integrity and size using agarose gel electrophoresis, enabling students to effectively visualize and assess the quality of isolated genomic and plasmid DNA, with emphasis on technique optimization and troubleshooting.

COURSE OUTCOME

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

CO-1:	Demonstrate the ability to recall and describe the techniques involved in isolating genomic DNA from various sources including bacteria, plants, and animal cells.	K1
CO-2:	Explain the principles and steps involved in the isolation of plasmid DNA from bacteria and differentiate between genomic and plasmid DNA in terms of structure, function, and isolation methods.	K2
CO-3:	Perform the isolation of genomic DNA from bacterial, plant, and animal cell samples using appropriate methods and tools, ensuring that the DNA extracted is of suitable quality for subsequent experiments.	K3
CO-4:	Analyze the purity and concentration of isolated genomic and plasmid DNA using a spectrophotometer and agarose gel electrophoresis, interpreting the results for accurate assessment.	K4
CO-5:	Analyze the purity and concentration of isolated genomic and plasmid DNA using a spectrophotometer and agarose gel electrophoresis, interpreting the results for accurate assessment.	K3
CO-6:	Compare and contrast the different methods of DNA isolation and evaluate the advantages and limitations of each technique in the context of various biological samples.	K4

COURSE CONTENT:

Experiment Number	Title	Duration
1	Isolation of Genomic DNA from Bacteria	**60 Hours**
2	Isolation of Genomic DNA from Plant	
3	Isolation of Genomic DNA from Animal Cells	
4	Isolation of Plasmid DNA from Bacteria	
5	Agarose Gel Electrophoresis of Genomic and Plasmid DNA	
6.	Quantification and Quality checking of nucleic acid using spectrophotometer	
7.	Review and assessment	

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WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Cell Biology Lab	**Subject Code:** TIU-PBT-L127
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

- To introduce students to the practical aspects of plasmolysis and deplasmolysis
- To equip students with the skills to isolate and culture primary and secondary cells
- To provide practical experience in protein analysis using SDS-PAGE
- Learn to use a light microscope to observe prokaryotic and eukaryotic cells and apply basic staining techniques.
- Examine prepared slides of onion root tips and testis tissues to identify different stages of mitosis and meiosis.

COURSE OUTCOME

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

CO-1:	Use a light microscope effectively to observe prokaryotic and eukaryotic cells and apply staining techniques.	K1
CO-2:	Explain the concepts and techniques involved in **primary cell culture from adult zebrafish** and discuss the significance of using zebrafish as a model organism in cell biology research.	K2
CO-3:	Perform **primary and secondary cell cultures**, demonstrating the ability to isolate and maintain healthy cultures, and follow proper aseptic techniques to ensure contamination-free results.	K3
CO-4:	Analyze and interpret results from **SDS-PAGE** to assess the molecular weight of proteins in a given sample, comparing bands and identifying proteins based on known molecular markers.	K4
CO-5:	Identify various stages of mitosis and meiosis from prepared slides and explain their significance in cell division.	K3
CO-6:	Describe the **process of plasmolysis and deplasmolysis**, including the role of osmosis and tonicity in plant cells.	K2

COURSE CONTENT:

Experiment Number	Title	Duration
1	Using a light microscope to observe prokaryotic and eukaryotic cells, staining techniques (e.g., methylene blue, iodine).	60 Hours
2	Observingcell components using differential staining techniques (e.g., Gram staining for bacteria).	
3	Studying the effect of different solutions on plant/animal cells (e.g., onion cells in hypertonic and hypotonic solutions).	
4	Primary and Secondary cell culture	
5.	Examining prepared slides of onion root tip and testis for different stages of cell division.	
6	Isolating DNA from plant, animal, or bacterial cells using simple methods.	
7	Electrophoretic Techniques, SDS PAGE and Native PAGE	

Books:

1. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012, ISBN-10: 1107422221, ISBN-13: 978-1107422223.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, Second Edition (Springer Series in Statistics), 2016, ISBN-10: 0387848576, ISBN-13: 978-0387848570.
3. Christopher Bishop, “Pattern Recognition and Machine Learning (Information Science and Statistics)”, Springer, 2007.

4. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012, ISBN-10: 0262018020, ISBN-13: 978-0262018029
5. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012 ISBN 13: 978-1600490064.
6. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997, ISBN-10: 0071154671, ISBN-13: 978-0071154673.
7. Jiawei Han, Micheline Kamber, “Data Mining Concepts and Techniques”, Chris Ullman, Morgan Kaufmann Publishers,Third Edition, 2011, ISBN 0123814790, ISBN-13 9780123814791.

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. Biotech	**Year, Semester:** 1st Yr., 1st Sem
Course Title: Entrepreneurship Skill Development	**Subject Code:** TIU-PES-S199
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

- Identify real-time scientific problems and evaluate their feasibility.
- Develop teamwork and collaborative problem-solving skills.
- Utilize brainstorming techniques to generate innovative solutions.
- Conduct initial research on materials, methods, and processes to assess solution viability.

COURSE OUTCOME:

CO No.	Course Outcome	

CO-1	Identifying relevant scientific challenges, analyzing their significance, and understanding industry needs.	K1
CO-2	Forming teams based on shared interests, strengths, and interdisciplinary expertise.	K1
CO-3	Evaluating the complexity of selected problems, assessing feasibility, and defining clear objectives.	K2
CO-4	Exploring innovative brainstorming methods to generate potential solutions.	K3
CO-5	Analyzing technical, economic, and logistical feasibility of different solution approaches.	K4
CO-6	Investigating foundational research, available technologies, and methodologies for solution development.	K4

COURSE CONTENT:

MODULE 1:	**IDENTIFYING PROBLEMS AND TEAM FORMATION**	**10 Hours**
Selecting real-time scientific problems. Forming teams based on interest areas. Understanding the scope of the problem and feasibility of solutions.		
MODULE 2:	**IDEA GENERATION AND INITIAL RESEARCH**	**20 Hours**
Brainstorming techniques for solution development. Assessing the practicality of different solutions. Initial discussions on materials, methods, and processes.		
TOTAL LECTURES		**30 Hours**

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc. Biotech	**Year, Semester:** 1st Yr., 1st Sem
Course Title: Skill Development -I	**Subject Code:**TIU-PBT-S101
Contact Hours/Week: 0–0-6 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Understand the importance of scientific communication in research and academia.
- Develop technical writing skills for research papers, reports, and theses.
- Apply ethical referencing and citation practices to maintain academic integrity.
- Enhance graphical and visual communication for scientific data representation.
- Prepare research proposals and manuscripts for publication and peer review.
- Communicate scientific findings effectively through spoken and media platforms.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Exploring the importance of effective communication in research and academia.	K1
CO-2	Analyzing oral, written, and visual communication methods and overcoming common challenges.	K2
CO-3	Adapting scientific content for different audiences to enhance clarity and impact.	K2
CO-4	Understanding the components of research papers, lab reports, and theses.	K3
CO-5	Delivering engaging oral presentations, handling Q&A, and writing for science blogs and social media.	K4
CO-6	Selecting journals, writing cover letters, and addressing reviewer feedback.	K4

COURSE CONTENT:

MODULE	COURSE CONTENT	CONTACT HOURS
MODULE 1	INTRODUCTION TO SCIENTIFIC COMMUNICATION: Importance in research and academia. Types of scientific communication – oral, written, visual. Common challenges in communicating science effectively. Audience analysis and tailoring content accordingly.	15 HOURS
MODULE 2	TECHNICAL WRITING: Components of scientific writing – abstract, introduction, methods, results, and discussion (IMRaD format). Guidelines for writing research papers, lab reports, and theses. Common errors in scientific writing. Scientific tone and style.	15 HOURS
MODULE 3	REFERENCE MANAGEMENT AND ETHICS: Referencing styles (APA, MLA, Vancouver, etc.), Citation tools (Zotero, Mendeley, EndNote). Avoiding plagiarism, paraphrasing and summarizing, academic integrity, and copyright issues.	15 HOURS
MODULE 4	GRAPHICAL AND VISUAL COMMUNICATION: Preparing scientific posters and presentations. Designing effective graphs, charts, and tables. Use of tools like MS Excel, GraphPad Prism, Canva, and PowerPoint. Data visualization principles.	15 HOURS
MODULE 5	RESEARCH PROPOSAL & MANUSCRIPT PREPARATION: Structure of research proposals, hypothesis writing, defining objectives and methodology. Peer review process, journal selection, cover letter writing, responding to reviewer comments.	15 HOURS

MODULE 6	SPOKEN AND MEDIA COMMUNICATION: Elevator pitch, oral presentations, handling Q&A. Science communication to non-expert audiences, writing for popular science magazines, blogs, and social media.	15 HOURS
TOTAL		90 HOURS

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Immunology	**Subject Code:** TIU-PBT-T102
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Introduce students to the basic concepts of immunology, including the structure and function of immune cells, organs, and mechanisms of innate and adaptive immunity.
- Explain the interactions between antigens and antibodies, antigen presentation, cytokines, and immune signaling pathways, as well as their roles in health and disease.
- Examine immune-related diseases such as autoimmunity, hypersensitivity, immunodeficiency, and tumor immunology, while also introducing key immunological techniques and vaccine development strategies.

COURSE OUTCOME:

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

CO-1:	Define and describe the fundamental concepts of immunology, including the immune system, its components, and the types of immunity.	K1
CO-2:	Explain the structure, functions, and interactions of antigens, antibodies, and immunoglobulins, along with antigen-antibody reactions and complement activation mechanisms.	K2
CO-3:	Apply immunological principles to understand host immune responses to bacterial, viral, fungal, and parasitic infections, as well as mechanisms of hypersensitivity, autoimmunity, and transplantation immunology.	K3
CO-4:	Demonstrate the role of immunological processes in tumor immunity, immunodeficiency diseases, and vaccine development, including active and passive immunization strategies.	K3
CO-5:	Analyze different immunological techniques such as immunodiffusion, ELISA, immunofluorescence, and hybridoma technology to assess immune responses in clinical and research settings.	K4
CO-6:	Evaluate modern immunotherapeutic strategies, including monoclonal antibody therapy, recombinant vaccines, and emerging immunotechnologies	K4

COURSE CONTENT :

MODULE 1:	**Basic Concept of immunology**	**15 Hours**
Basic concept of immunology: Introduction; overview of the immune system; Cells and organs of Immune system: Hematopoietic stem cells; Stromal cells; Hematopoietic growth factors; Lymphoid organs (primary and secondary) and cells; Mononuclear cells; Granulocytic cells; Mast cells; Dendritic cells- characteristics and functions; Types of Immunity: Innate immunity - mechanism of immune response (anatomic; physiological; phagocytic and inflammatory barriers); Adaptive immunity: Humoral and Cell-mediated immunity; Mechanism of immune response---antigen processing and presentation; types and structures of Major Histocompatibility Complex molecules (MHC) and their role in antigen presentation; clonal selection of lymphocytes; definition of cytokine; generation of humoral and cell mediated response by cellular interactions (general concept only).		
MODULE 2:	**Antigen and antibody**	**10 Hours**
Concept of antigen; Chemical nature; antigenicity; immunogenicity; hapten; epitopes; mitogens (definition; properties; examples); Adjuvant; Immunoglobulins: Isotypes- definition; basic and fine structures; general characteristics and functions. Monoclonal and polyclonal antibody (definition and characteristics); Antigen - Antibody interactions: Precipitation reactions-Radial immunodiffusion; double immunodiffusion; immunoelectrophoresis; Agglutination reactions-Hemagglutination; passive agglutination; bacterial agglutination; agglutination inhibition; Important features of both categories of antibodies; Complement: The complement components; function; complement activation.		
MODULE 3:	Immunity to infection	**15 Hours**

Immunity to Infection: Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology–Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency-Primary immunodeficiencies, Acquired or secondary immunodeficiency. Vaccines: Active and passive immunization (definition; characteristics; examples and functions); Attenuated and inactivated viral or bacterial vaccines (definition; characteristic; functions; examples); Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, Peptide vaccines, conjugate vaccines.		
MODULE 4:	Immunological techniques	**5 Hours**
Immunological techniques: One and two dimensional single radial immunodiffusion; Ouchterlony immunodiffusion; Rocket immunoelectrophoresis; ELISA; Direct, indirect and Sandwich immunofluorescence; hybridoma technology and monoclonal antibody production		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Bacteriology and Virology	**Subject Code:** TIU-PBT-T114
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Provide an understanding of the historical developments, classification, and morphology of bacteria and viruses, along with their biological significance and applications in biotechnology.
- Equip students with knowledge of bacterial isolation techniques, microbial nutrition, growth kinetics, and various physical and chemical methods for controlling microbial growth, including sterilization and disinfection.

- Explain the unique characteristics of viruses, their classification based on genetic material, replication mechanisms, interactions with host cells, and their roles in human diseases, including cancer-causing viruses and emerging viral pathogens.

COURSE OUTCOME:

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

CO-1:	Explain the historical developments in microbiology, including spontaneous generation, biogenesis, germ theory, Koch's postulates, and the classification of microorganisms.	K1
CO-2:	Describe the morphology, structural components, and classification of bacteria and archaea, along with their significance in biotechnology.	K2
CO-3:	Demonstrate various bacterial culture techniques, including isolation, enrichment, and maintenance of microbial cultures, as well as methods for microbial identification.	K3
CO-4:	Analyze bacterial growth kinetics, the effect of environmental factors on microbial growth, and different methods of microbial control, including sterilization, disinfection, and chemotherapeutic agents.	K3
CO-5:	Differentiate between bacteria and viruses based on their structural, genetic, and replication mechanisms, including lytic and lysogenic cycles..	K4
CO-6:	Evaluate the role of viruses in human diseases, including oncogenic viruses, and explain the mechanisms of viroids, prions, and bacteriophage replication. These COs ensure a balanced progression	K4

COURSE CONTENT:

MODULE 1:		**15 Hours**
History and notable contributions in the development of Microbiology: i) Spontaneous generation (abiogenesis) ii) Biogenesis iii) Germ Theory of Disease iv) Koch's Postulates v) Scope of Microbiology; Position of microorganisms in biological world: Whittaker's Five-kingdom and three-kingdom concept of living organisms (General characteristics of those groups); General features of Eubacteria and Archaebacteria (major difference within Eubacteria). Brief account of all group of bacteria and cyanobacteria, Rickettsia, Chlamydia and Mycoplasma; Archaea :Archaebacteria and extremophilic microbes – their biotechnological potentials, bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy / classification including ribotyping and ribosomal RNA sequencing, Study of bacterial morphology: Classification of bacteria according to morphology and staining; Exospores & Cysts: types & structure; Endospore; Flagella; Pilus; Fimbriae (structure; composition and functions); Plasmids and episomes, Nuclear material; Bacterial Chromosome		
MODULE 2:		**5 Hours**
Isolation of pure culture by serial dilution, spread plating, streaking and pour plating,, Methods of maintenance and preservation of microbial cultures, Enrichment culture techniques		

MODULE 3:		**15 Hours**
Microbial Nutrition: Nutritional types (definition and example) - Photoautotrophs; Photoorganotrophs; Chemolithotrophs (ammonia; nitrite; sulfur; hydrogen; iron oxidizing bacteria); Chemoorganotrophs; Effect of oxygen on growth - classification on the basis of oxygen requirement and tolerance. Bacterial Growth: Growth phases - Generation time; Kinetics of growth: Batch culture, Continuous culture, Synchronous culture (definition and brief description); Physical factors influencing growth – Temperature, pH, osmotic pressure, salt concentration. Control of growth of Microbes: Sterilization; disinfection; antiseptic; sanitizer; germicide; antimicrobial agent (definition; application & examples); physical method of disinfection and sterilization - dry heat; moist heat; filtration; radiation (mode of action; applications); Chemical control – dye solutions; alcohol; acid; alkali; halogen; heavy metal; phenol; phenol derivatives; formaldehyde; ethylene oxide; detergents (mode of action; applications). Assessment of chemical disinfectant; phenol coefficient-definition and method of determination; Chemotherapeutic agents - sulphonamides; antibiotics; (definition types); mechanism of action and antimicrobial spectrum of penicillin, streptomycin, tetracycline, chloramphenicol, Nalidixic acid and metronidazole; drug resistance - phenomena and mechanism**.**		
MODULE 4:		**10 Hours**
Virology: General characteristics of viruses: What are viruses? Difference between bacteria and viruses; Components of viruses; sizes and shapes of different viruses (describe with at least one example); host range and specificity; Classification of viruses based on the nucleic acid content: DNA (dsDNA; ssDNA) and RNA (ssRNA; dsRNA) viruses with examples: Human cancer viruses (SV40; HTLV - 1 & 2; Epstein-Barr virus only) Virus like agents: viroids and prions (concept and significance); Viral replication: General characteristics of replication; Replication of T4 phage; Phage growth and the estimation of phage numbers; Lytic and lysogenic life cycle of bacteriophage lambda; mechanism(s) that determines lytic and lysogenic life cycle**.**		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Plant Biotechnology	**Subject Code:** TIU-PBT-T128
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- To impart knowledge on molecular markers, genome mapping, gene cloning strategies, and genetic transformation techniques for plant biotechnology applications.
- To develop an understanding of gene transfer methods, molecular stress responses, and genetic engineering approaches for improving crop traits such as pest resistance, abiotic stress tolerance, and nutritional enhancement.
- To equip students with practical skills in plant tissue culture, somatic hybridization, embryo rescue, RNAi technology, and biofortification for crop improvement and sustainable agriculture.

COURSE OUTCOME :

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

CO-1:	Explain the principles, types, and applications of DNA molecular markers, gene mapping, and genome analysis techniques used in plant biotechnology.	K1
CO-2:	Describe various gene transfer methods in plants, molecular mechanisms of stress responses, and the role of genetic engineering in crop improvement.	K2
CO-3:	Demonstrate proficiency in gene cloning, transformation strategies, and molecular analysis of transgenic plants while considering biosafety norms and IPR regulations.	K3
CO-4:	Utilize plant tissue culture techniques such as anther culture, somatic hybridization, and embryo rescue for crop improvement and secondary metabolite production.	K3
CO-5:	Analyze the significance of signal transduction in plant stress responses and evaluate the applications of RNAi technology, gene pyramiding, and gene fusion in plant biotechnology.	K4
CO-6:	Assess the role of biotechnological approaches in developing transgenic plants with improved traits such as pest resistance, abiotic stress tolerance, and enhanced nutritional value.	K4

COURSE CONTENT :

MODULE 1:		**15 Hours**
DNA molecular markers; Principles, type and applications; RFLP, AFLP, RAPD, SSR, SNP, Structural and functional genomics, gene mapping, genome mapping, gene tagging and comparative genomics and applications, Restriction enzymes and their uses, Salient features of most commonly used vectors i.e. plasmids, bactetiophages, phagmids, cosmids, BACs and PACs, YACs, binary vectors, expression vectors, Gene cloning and sub-cloning strategies, chromosome walking, genetic transformation, Risk assessment and IPR		
MODULE 2:		**15 Hours**
Isolation of genes of economic importance, Gene construction for tissue-specific expression, Different methods of gene transfer to plants, *viz.* direct and vector-mediated, Molecular analysis of transformants, Molecular biology of various stresses like drought, salt, heavy metals and temperature, and biotic stresses like bacterial, fungal and viral diseases, Signal transduction and its molecular basis, Potential applications of plant genetic engineering for crop improvement, i.e. insect-pest resistance, abiotic stress resistance, herbicide resistance, storage protein quality, increasing shelf-life, oil quality, Current status of transgenics, biosafety norms and controlled field trials and release of transgenics (GMOs)		
MODULE 3:		**15 Hours**

Basic techniques in cell culture and somatic cell genesis, Clonal propagation, Concept of cellular totipotency, Anther culture, Somaclonal and gametoclonal variations, Hybrid embryo culture and embryo rescue, Somatic hybridization and cybridization, Application of tissue culture in crop improvement, Secondary metabolite production, Bioprospecting, Biofortification, Gene pyramiding and gene fusion, RNAi technology, *In vitro* mutagenesis, cryopreservation and plant culture repository	
TOTAL LECTURES	**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Recombinant DNA Technology	**Subject Code:** TIU-PBT-T126
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- To provide foundational knowledge of recombinant DNA technology, including restriction enzymes, DNA modification enzymes, hybridization techniques, and DNA-protein interaction assays.
- To develop an understanding of various cloning vectors, molecular cloning techniques, gene expression systems, and advanced genome-editing tools such as CRISPR-Cas9.

- To equip students with practical skills in PCR-based applications, DNA sequencing, gene silencing, and the development of genetically engineered organisms for applications in healthcare, agriculture, and industry.

COURSE OUTCOME:

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

CO-1:	Explain the fundamental concepts of recombinant DNA technology, including restriction enzymes, DNA ligases, and various molecular biology tools..	K1
CO-2:	Illustrate the principles and types of cloning vectors, their role in genetic engineering, and their application in different host systems.	K2
CO-3:	Demonstrate proficiency in molecular cloning techniques, genomic and cDNA library construction, and hybridization-based detection methods.	K3
CO-4:	Utilize PCR-based techniques, DNA sequencing methods, and gene editing tools for gene identification, amplification, and modification.	K3
CO-5:	Compare and contrast different gene silencing techniques, site-directed mutagenesis approaches, and molecular diagnostics strategies.	K4
CO-6:	Evaluate the applications of recombinant DNA technology in the development of transgenic organisms, gene therapy, and pharmaceutical production.	K4

COURSE CONTENT:

MODULE 1:		**15 Hours**
Basics Concepts of rDNA technology; Restriction Enzymes; DNA ligase; Modificationmethylases and other enzymes needed in genetic engineering; Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; DNA-Protein Interactions-Electromobility shift assay; DNaseIfootprinting.		
MODULE 2:		**10 Hours**
Cloning vectors: Plasmids; Bacteriophages; M13 vectors; PUC19 and Bluescriptvectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo& retroviral vectors; Expression vectors; Protein purification; His-tag; Plant based vectors: Ti and Ri as vectors, Yeast vectors, Shuttle vectors.		
MODULE 3:		**15 Hours**

Molecular cloning: Recombinant DNA techniques; construction of genomic DNAand cDNA libraries; screening of recombinants, Reporter assays; Sequencing of DNA: Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; Site-directed mutagenesis; gene replacement and gene targeting, Gene silencing techniques: Introduction to siRNA; siRNA technology. Polymerase chain reaction and its applications: Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T/Avectors; Proof reading enzymes; PCR in gene recombination; deletion; addition; Overlap extension; Site specific mutagenesis, RFLP, RAPD and AFLP		
MODULE 4:		**05 Hours**
Applications of genetic engineering: Transgenic animals; production ofrecombinant pharmaceuticals; gene therapy; disease diagnosis, CRISPR, Cas9		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Bioenergetics and metabolism	**Subject Code:** TIU-PBT-T130
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. To provide a fundamental understanding of bioenergetics, including the organization and function of mitochondria, the electron transport chain, oxidative phosphorylation, and the chemiosmotic hypothesis.

2. To explore the metabolic pathways of essential biomolecules, such as carbohydrates, amino acids, lipids, and nucleotides, and their roles in cellular energy production and regulation.
3. To analyze key biochemical cycles, including glycolysis and the TCA cycle, emphasizing their interconnections, energy yield, and metabolic significance in biological systems.

COURSE OUTCOME:

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

CO-1:	Describe the organization and function of mitochondria, including their role in energy transduction and the endosymbiotic hypothesis.	K1
CO-2:	Explain the electron transport chain (ETC) and oxidative phosphorylation mechanism, highlighting the chemiosmotic hypothesis and energy generation in cells.	K2
CO-3:	Interpret the role of respiratory chain inhibitors, uncouplers, and coupled reactions in regulating cellular respiration and energy production.	K2
CO-4:	Illustrate the metabolic pathways of carbohydrates, amino acids, lipids, and nucleotides, outlining their significance in energy production and biosynthesis.	K3
CO-5:	Compare and contrast the glycolysis and TCA cycle, explaining their biochemical interconnections and importance in cellular metabolism.	K3
CO-6:	Analyze how different metabolic pathways integrate and regulate cellular functions, demonstrating their role in maintaining homeostasis and energy balance.	K4

COURSE CONTENT:

MODULE 1:	**Bioenergetics:**	**20 Hours**
Organization and function of mitochondria, endosymbioant hypothesis for the biogenesis of mitochondria, electron transport chain, mechanism of oxidative phosphorylation, chemiosmotic hypothesis, respiratory chain inhibitors, coupled reaction, uncouplers, biological energy transducers.		
MODULE 2:	**Fundamentals of metabolisms:**	**25 Hours**
Metabolism of carbohydrates, amino acids, lipids and nucleotides. Outlines of glycolysis and TCA cycle.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Cell and Immunology lab	**Subject Code:** TIU-PBT-L130
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

- To introduce fundamental immunological techniques such as Ouchterlony double diffusion, ELISA, immunoelectrophoresis, and Western blotting for the detection and characterization of antigens and antibodies.
- To develop hands-on skills in cell culture techniques, including lymphocyte isolation and animal cell culture, for studying immune cell functions and responses in vitro.
- To enable students to analyze and interpret immunological data, fostering an understanding of antigen-antibody interactions, protein expression analysis, and immune response mechanisms through practical applications.

COURSE OUTCOME:

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

CO-1:	Describe the principles and techniques used in immunological assays such as Ouchterlony double diffusion, DOT ELISA, and quantitative ELISA.	K1
CO-2:	Explain the mechanisms and applications of immunoelectrophoresis and Western blotting in detecting and analyzing proteins.	K2
CO-3:	Demonstrate an understanding of lymphocyte isolation and culture techniques, explaining their significance in immunological research and applications.	K2
CO-4:	Perform and interpret immunoassays (ELISA, Western blotting, and immunoelectrophoresis) for detecting antigens and antibodies in biological samples.	K3
CO-5:	Execute animal cell culture techniques, ensuring aseptic conditions and analyzing cell growth and viability under controlled conditions.	K3
CO-6:	Analyze and evaluate the results from immunological experiments, drawing conclusions on antigen-antibody interactions, protein identification, and immune response mechanisms.	K4

COURSE CONTENT:

Experiment Number	Course content	Duration
1	Assessment of antigen similarity using Ouchterlony double diffusion test	**60 Hours**
2	DOT ELISA test	
3	Quantitative ELISA	
4	Immunoelectrophoresis	
5	Western Blotting	
6	Lymphocyte Isolation & Culture	
7	Animal Cell Culture	

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Basic Genetic engineering Lab	**Subject Code:** TIU-PBT-L124
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

- To provide hands-on experience in fundamental genetic engineering techniques, including genomic and plasmid DNA isolation, PCR amplification, and restriction digestion for molecular analysis.
- To develop proficiency in recombinant DNA technology, focusing on cloning, transformation, and selection of genetically modified bacterial colonies for gene expression studies.
- To enable students to analyze and interpret experimental results, utilizing agarose gel electrophoresis, restriction mapping, and molecular characterization of transformed colonies.

COURSE OUTCOME :

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

CO-1:	Recollect the principles and techniques of DNA isolation, PCR amplification, and restriction digestion used in genetic engineering.	K1
CO-2:	Explain the mechanisms of plasmid isolation, cloning strategies, and transformation techniques for gene manipulation.	K2
CO-3:	Perform agarose gel electrophoresis, restriction digestion, and PCR analysis to evaluate DNA samples and genetic modifications.	K3
CO-4:	Demonstrate the ability to clone a gene of interest into a plasmid vector and transform bacterial cells, ensuring successful genetic modification.	K3
CO-5:	Analyze and interpret experimental results from gel electrophoresis, restriction mapping, and colony screening for successful transformation.	K4
CO-6:	Evaluate the effectiveness of genetic engineering techniques by identifying and characterizing transformed bacterial colonies.	K4

COURSE CONTENT :

Experiment Number	Course content	Duration
1	Isolation of genomic DNA from bacteria/plant	60 Hours
2	PCR amplification of Gene of Interest	
3	Miniprep isolation of plasmid DNA	
4	Restriction digestion of plasmid DNA and agarose gel electrophoresis of restriction digests and PCR products	
5	Cloning of PCR product into the isolated plasmid and transformation	
6	Identification and characterization of transformed colonies	
7	cDNA synthesis and amplification of GOI	

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 1st Yr** 2nd Sem.
Course Title: Bacteriology and Virology Lab	**Subject Code:** TIU-PBT-L132
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

- To develop proficiency in fundamental microbiological techniques, including media preparation, bacterial culture, isolation, and staining methods for morphological and structural identification.
- To provide hands-on experience in bacterial growth analysis and biochemical characterization, enabling students to perform viable cell counting, metabolic tests, and antibiotic sensitivity assays.
- To enhance analytical and problem-solving skills by applying microbiological techniques to identify bacterial species, study their growth dynamics, and evaluate their biochemical and physiological properties.

COURSE OUTCOME :

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

CO-1:	Recollection of fundamental microbiological techniques, including media preparation, bacterial isolation, and staining methods for bacterial identification.	K1
CO-2:	Explain the principles of bacterial staining, growth curve analysis, and biochemical characterization for microbial identification and classification.	K2
CO-3:	Perform isolation and identification of bacterial species using pure culture techniques, dilution plating, and staining methods.	K3
CO-4:	Conduct biochemical tests (IMViC, catalase, oxidase, urease, etc.) to characterize bacterial metabolic capabilities and differentiate species.	K3
CO-5:	Analyze and interpret growth patterns, viable cell counts, and antibiotic sensitivity data using scientific techniques such as the disc diffusion method.	K4
CO-6:	Evaluate bacterial physiological and metabolic properties through biochemical assays, hydrolysis tests, and antibiotic resistance profiling.	K4

COURSE CONTENT :

Experiment Number	Course content	Duration
1	Preparation of media and slants for bacterial culture	60 HOURS
2	Isolation of pure culture in slant techniques and by streak plate techniques	
3	Dilution plating for viable count	
4	Simple staining and gram staining of bacteria	
5	Endospore staining	
6	Determination of cell number, growth curve preparation	

7	Biochemical Characterization of Bacteria: Oxidation/Fermentation Test, Catalase, Oxidase, Urease, IMViC, H2S, Nitrate Reduction, Casein & Starch Hydrolysis	
8	Antibiotic Assay (Disc Diffusion Method)	

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Biotechnology

Program: M.Sc. Biotech	**Year, Semester:** 1st Yr., 2nd Sem
Course Title: Entrepreneurship Skill Development-I	**Subject Code:** TIU-PES-S198

Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

- Explore and analyze available scientific methods and alternative solutions.
- Evaluate the technical feasibility of proposed solutions through research and expert consultations.
- Understand market needs and industry trends to assess business viability.
- Apply SWOT analysis to determine the feasibility and applications of scientific solutions.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Identify and evaluate scientific methods and alternative solutions for problem-solving.	K1
CO-2	Conduct literature reviews and expert consultations to assess technical feasibility.	K2
CO-3	Analyze market trends and customer needs to determine potential applications.	K3
CO-4	Apply SWOT analysis to assess business feasibility and sustainability of solutions.	K4
CO-5	Analyse Entrepreneurship techniques	K4
CO-6	Analyse the customer needs	K4

COURSE CONTENT:

MODULE 1:	**RESEARCH ON SCIENTIFIC SOLUTIONS**	**15 Hours**
Studying available scientific methods and alternative solutions. Evaluating technical feasibility. Testing initial concepts through literature reviews and expert consultations.		
MODULE 2:	**MARKET AND BUSINESS FEASIBILITY**	**15 Hours**

Introduction to market needs and basic industry trends. SWOT analysis of the solution. Understanding customer needs and potential applications.	
TOTAL LECTURES	**30 Hours**

Department of Biotechnology

Program: M.Sc in Biotech	**Year, Semester: 1st Yr 2nd Sem.**
Course Title: Skill Development-II	**Subject Code: TIU-PBT-S100**
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the biology, types, and economic significance of edible and medicinal mushrooms.
2. Develop hands-on expertise in mushroom cultivation, harvesting, processing, and marketing strategies.
3. Learn the principles and practical aspects of vermicomposting, including unit setup and waste recycling techniques.
4. Explore entrepreneurship opportunities in sustainable agriculture, focusing on mushroom farming and vermicomposting.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Explain the fundamentals of mushroom biology and the economic potential of mushroom cultivation.	K1
CO-2	Demonstrate practical skills in mushroom cultivation, harvesting, and post-harvest management.	K2
CO-3	Apply vermicomposting techniques for organic waste recycling and sustainable agriculture.	K2
CO-4	Develop business strategies for commercialization of mushroom and vermicompost products.	K3
CO-5	Analyze packing strategies	K4
CO-6	Apply quality control and nutrient analysis	K4

Course content

Module	Course Content	Contact Hours
Module 1	Introduction to Mushroom Biology • Basics of fungal biology and life cycle • Edible and medicinal mushrooms: types and importance • History, scope, and economics of mushroom cultivation in India	**8 Hours**
Module 2	Mushroom Cultivation Techniques • Selection of species: Oyster, Button, Milky, Shiitake • Substrate selection and preparation • Spawn preparation and inoculation • Cultivation units: Beds, bags, and shelves • Environmental conditions and hygiene practices	**12 Hours**
Module 3	Harvesting, Processing and Preservation • Harvesting methods and post-harvest management • Packaging, storage, value addition (pickles, dried mushrooms) • Marketing strategies for mushroom products	**5 Hours**
Module 4	Introduction to Vermicomposting • Importance of organic waste recycling • Earthworm biology and suitable species for composting (Eisenia fetida, etc.) • Design and setup of a vermicompost unit	**8 Hours**
Module 5	**V**ermicomposting Process and Maintenance • Feedstock types and layering techniques • Monitoring moisture, temperature, and aeration • Common issues and troubleshooting	**6 Hours**
Module 6	Application, Packaging & Entrepreneurship • Harvesting and curing of vermicompost • Quality control and nutrient analysis • Commercialization, government schemes, startup opportunities	**6 Hours**
TOTAL		**45 HOURS**

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.

Course Title: Animal Biotechnology	**Subject Code:** TIU-PBT-T205
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- To introduce fundamental principles of animal cell culture, including media composition, culture systems, and cellular characteristics, enabling students to understand their applications in biotechnology.
- To develop technical skills in primary and established cell culture techniques, including cell cloning, viability assessment, cytotoxicity testing, and flow cytometry, for research and industrial applications.
- To explore the commercial applications of animal biotechnology, such as stem cell technology, hybridoma technology, monoclonal antibody production, vaccine development, and tissue engineering, for advancements in healthcare and biotechnology industries.

COURSE OUTCOME :

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

CO-1:	Describe the fundamental concepts of animal cell culture, including media composition, growth requirements, and different culture systems.	K1
CO-2:	Explain the principles of primary culture, cell lines, and their maintenance, along with methods for assessing viability, cytotoxicity, and cell synchronization.	K2
CO-3:	Demonstrate proficiency in mammalian cell culture techniques, including cell cloning, transformation, and apoptosis measurement for research and industrial applications.	K3
CO-4:	Utilize flow cytometry, hybridoma technology, and monoclonal antibody production in disease diagnosis, drug development, and therapeutic research.	K3
CO-5:	Evaluate the applications of stem cell technology, organ cultures, and tissue engineering in regenerative medicine and biopharmaceutical industries	K4
CO-6:	Analyzing: Assess the commercial applications of animal biotechnology, including vaccine production, large-scale cell culture, and screening systems for cytotoxicity testing.	K4

COURSE CONTENT :

MODULE 1:		**15 Hours**

Animal cell culture: Equipments and materials for animal cell culture technology. Various systems of cell culture; their distinguishing features; advantages and limitations; Culture medium: natural media; synthetic media; sera; Introduction to balanced salt solutions and simple growth medium; Brief discussion on the chemical; physical and metabolic functions of different constituents of culture medium; role of carbon dioxide; serum supplements. Characteristics of cells in culture: contact inhibition; anchorage dependence; cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.		
MODULE 2:		**10 Hours**
Primary culture: behavior of cells, properties, utility; Explant culture; suspension culture; Established cell line cultures: definition of cell lines, maintenance and management, cell adaptation; Measurement of viability and cytotoxicity; Cell cloning; cell synchronization and cell manipulation; Various methods of separation of cell types; advantages and limitations; flow cytometry.		
MODULE 3:		**10 Hours**
Basic techniques of mammalian cell cultures in vitro: Serum & protein free defined media and their applications; Measurement of viability and cytotoxicity; Cell synchronization; Cell transformation; Scaling up of animal cell culture; Stem cell cultures; embryonic stem cells and their applications; Somatic cell genetics; Apoptosis: Measurement of cell death		
Module 4:		10 hours
Commercial applications of cell culture: Stem cells and their applications, Hybridoma Technology and Monoclonal antibodies; Tissue culture as a screening system; cytotoxicity and diagnostic tests; Mass production of biologically important compounds (e.g. Vaccines); Harvesting of products; purification and assays; Organ cultures and tissue engineering		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.
Course Title: Bioprocess Engineering and Downstream Processing	**Subject Code:** TIU-PBT-T207
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- To provide a comprehensive understanding of bioprocess technology, including upstream and downstream processing, fermentation techniques, and microbial growth kinetics.
- To familiarize students with bioreactor design and operation, including different types of bioreactors and their applications in microbial, plant, and mammalian cell cultures.
- To equip students with knowledge of downstream processing techniques, including cell disruption, separation, purification, and drying methods used in biotechnological product recovery.

COURSE OUTCOME :

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

CO-1:	Understand the fundamental principles of bioprocess engineering by explaining upstream and downstream processes, different fermentation modes, and media formulation	K1
CO-2:	Analyze microbial growth kinetics and stoichiometry by evaluating factors affecting microbial growth and different measurement techniques.	K2
CO-3:	Demonstrate knowledge of various bioreactor designs and assess their applicability in microbial, plant, and mammalian cell cultures, including rheological considerations.	K3
CO-4:	Apply different cell disruption and solid-liquid separation techniques such as centrifugation, filtration, and flocculation for product recovery in downstream processing	K3
CO-5:	Evaluate membrane-based separation, chromatographic techniques, and crystallization methods for purification and recovery of biotechnological products.	K4
CO-6:	Illustrate industrial drying methods like freeze-drying and spray-drying to enhance product stability and shelf-life in bioprocess applications	K4

COURSE CONTENT :

MODULE 1:		**10 Hours**
Introduction to bioprocess technology, upstream processing -media formulation, sterilization amd strain improvement, and downstream processing, Modes of fermentation- Batch, fed batch and continuous, solid state and submerged fermentation.		
MODULE 2:		**05 Hours**
Microbial growth: Factors affecting microbial growth; Stoichiometry: mass balances; Growth kinetics; Measurement of growth		
MODULE 3:		**10 Hours**
Bioreactors: Introduction to bioreactors; Bioreactor types- packed bed, CSTR, Packed bed, photobioreactor, membrane bioreactor, Culture-specific design aspects: plant/mammalian cell culture reactors, rheology of the fermentation broth		
Module 4:		20 hours
Downstream Processing: Cell disruption techniques for intracellular product separation, Solid-Liquid separation techniques-Filtration; Cross flow & End Flow Filtration, Centrifugation: Analytical and Preparative Ultracentrifugation; Different types: Density gradient, Isopycnic; Rate zonal centrifugation etc, Flocculation, Sedimentation. Membrane based separation (MSP)-Microfiltration, Ultrafiltration, Reverse Osmosis, Dialysis. Liquid liquid extraction, Precipitation, Chromatographic Separation Techniques, Theory, Types. Gel Permeation, Ion Exchange, Affinity Chromatography, HPLC, UPLC, GC etc.Crystallization:- Principles-Nucleation- Crystal growth-Kinetics. Drying –Principles-Water in biological solids, Vacuum shelf and rotary dryer, Freeze dryer and Spray dryer		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.
Course Title: Genetics and statistics	**Subject Code:** TIU-PBT-T209
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- To provide a strong foundation in genetic principles, including Mendelian and non-Mendelian inheritance, gene mapping, microbial genetics, and chromosomal alterations.
- To develop an understanding of mutation mechanisms and recombination, emphasizing their roles in genetic variation, inheritance patterns, and evolutionary significance.
- To equip students with statistical tools and techniques, including probability distributions, hypothesis testing, regression, correlation, and multivariate analysis for biological data interpretation.

COURSE OUTCOME :

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

CO-1:	Explain Mendelian and non-Mendelian inheritance, gene interactions, and chromosomal behavior in inheritance.	K1
CO-2:	Demonstrate knowledge of linkage mapping, tetrad analysis, and the role of molecular markers in genetic mapping.	K2
CO-3:	Compare different modes of genetic transfer in microbes and analyze human genetic disorders using pedigree analysis and karyotyping.	K3
CO-4:	Classify different types of mutations and structural chromosomal changes while assessing their genetic implications.	K3
CO-5:	Utilize statistical methods such as probability distributions, hypothesis testing, regression, and ANOVA for data analysis in genetics and biotechnology.	K4
CO-6:	Explain homologous and non-homologous recombination mechanisms and their roles in genome evolution and genetic engineering.	K4

COURSE CONTENT :

MODULE 1:	**Mendelian principles**	**7 Hours**
Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.		
MODULE 2:	**Gene mapping methods**	**10 Hours**
Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.		
MODULE 3:	**Microbial genetics**	**10 Hours**
Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.		
Module 4:	**Mutation**	10 hours
Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications. **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.		
Module 5:	**Statistical Methods**	**8 hours**
Statistical Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; X^2 test;; basic introduction to Multivariate statistics, etc.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.
Course Title: Microbial Ecology	**Subject Code:** TIU-PBT-T211
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- To provide a strong foundation in genetic principles, including Mendelian and non-Mendelian inheritance, gene mapping, microbial genetics, and chromosomal alterations.
- To develop an understanding of mutation mechanisms and recombination, emphasizing their roles in genetic variation, inheritance patterns, and evolutionary significance.
- To equip students with statistical tools and techniques, including probability distributions, hypothesis testing, regression, correlation, and multivariate analysis for biological data interpretation.

COURSE OUTCOME :

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

CO-1:	Explain microbial functions in ecosystems, their influence on climate change, and their roles in biofilm formation.	K1
CO-2:	Identify and classify microorganisms present in different environments and apply microbiological analysis techniques to assess microbial populations.	K2
CO-3:	Compare different types of microbial interactions, including symbiosis, commensalism, and competition, and evaluate their roles in biological nitrogen fixation and biofertilizer production.	K3
CO-4:	Investigate microbial adaptations in marine ecosystems, including biofilms, quorum sensing, and their contributions to carbon cycling and eutrophication.	K3
CO-5:	Describe disease transmission mechanisms, analyze epidemiological factors, and assess the impact of microbial infections on public health.	K4
CO-6:	Explain host-microbe interactions, mechanisms of pathogen entry, virulence factors, and toxin production in microbial infections.	K4

COURSE CONTENT :

MODULE 1:		**10 Hours**
Introduction to microbial ecology: overview, History, applications Microbial functions in ecosystems and global cycles, Harmful microbes (biofouling and bio deterioration and pathogenic microbes), Microbial processes and climate change, Characterization of microbial communities by PCR, real-time PCR, molecular fingerprints, FISH, sequencing, pyrosequencing, biofilm formation.		
MODULE 2:		**12 Hours**
: Microbiology of air, water and soil: Different types of microorganisms in the air, aerosols, Microbiological analysis of water (total count, indicative organism), B.O.D. & C.O.D. - determination and implication, Physical and chemical characteristics of various microbial groups in soil; Rhizosphere, Phyllosphere; Brief account of microbial interactions - (symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism, and predation); Biological nitrogen fixation - symbiotic and asymbiotic; Root -nodule formation in legumes; Compost and Biofertilizers		
MODULE 3:		**12 Hours**
Marine microbiology: What is marine microbiology, Biological organization and the evolution of life, The world's oceans and seas, Chemical and physical factors in the marine environment, Marine microbial habitats - water column, Sediments, coastal ecosystems, mangroves salt marshes, Biofilms and Microbial mats, Microbial life at surfaces of living and non-living systems, Quorum sensing in marine microbes and significance, Carbon cycling in the oceans, Photosynthesis and primary productivity, Microbial processes in eutrophication of coastal waters.		
Module 4:		11 hours
Microbial Diseases: Disease reservoirs; epidemiological terminologies; infectious disease transmission; respiratory infections caused by bacteria and viruses; tuberculosis; sexually transmitted diseases including AIDS; diseases transmitted by animals (rabies, plague), insects and ticks (rickettisias. lyme disease, malaria), food and water borne diseases; public health and water quality; pathogenic fungi; emerging and resurgent infectious diseases. Host-parasite relationships: Normal microflora if skin, oral cavity, gastrointestinal tract; entry of pathogens into the host; colonization and factors predicted to infections; types of toxins (Exo, Endo-, Entero) and their structure; mode of actions; virulence and pathogenesis.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.
Course Title: Environmental Chemistry Lab	**Subject Code:** TIU-PBT-L203
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

- Develop analytical skills for environmental monitoring – Learn techniques for measuring pH, buffer capacity, alkalinity, and conductivity in water and soil samples to assess environmental quality.
- Understand pollution assessment methods – Apply fluorimetric and partition coefficient determination techniques to analyze organic pollutants, including polycyclic aromatic hydrocarbons.
- Evaluate wastewater contamination and treatment efficiency – Perform biochemical estimations of BOD and COD to assess the impact of pollutants and the effectiveness of wastewater treatment processes.

COURSE OUTCOME :

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

CO-1:	Evaluation of fundamental principles of environmental chemistry, including pH, buffer capacity, alkalinity, and conductivity in water and soil samples.	K1
CO-2:	Explain the significance of chemical parameters such as total dissolved solids (TDS) and alkalinity in assessing environmental water quality..	K2
CO-3:	Perform fluorimetric analysis and determine partition coefficients to evaluate the presence and distribution of organic pollutants, including polycyclic aromatic hydrocarbons.	K3
CO-4:	Utilize analytical techniques to assess the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) of wastewater to determine pollution levels.	K3
CO-5:	Interpret experimental data to assess the impact of pollutants on environmental systems and propose potential remediation strategies.	K4
CO-6:	Compare different environmental samples based on their chemical properties and evaluate their implications on water and soil quality	K4

COURSE CONTENT:

Experiment Number	Title	Duration
1	The pH and Buffer Capacity of Environmental Waters and Soil Samples	60 Hours
2	Alkalinity of Streams and Lakes	
3	Conductivity of Various Waters (TDS)	
4	Fluorimetric Determination of Polycyclic Aromatic Hydrocarbons	
5	Determination of Partition Coefficient for Organic Pollutants	
6	Bio-estimation of BOD and COD of Waste Water	

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc in Biotech	**Year, Semester: 2nd Yr** 3rd Sem.
Course Title: Bioprocess engineering and downstream processing Lab	**Subject Code:** TIU-PBT-L207
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

- To develop practical skills in enzyme kinetics by determining kinetic parameters (Vmax and Km) using spectrophotometric methods.
- To understand the influence of environmental factors such as pH and temperature on enzyme activity and stability in bioprocess applications.
- To analyze enzyme inhibition mechanisms and isozyme variations through experimental assays, enhancing comprehension of enzyme regulation in biological systems.

COURSE OUTCOME :

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

CO-1:	Evaluate the fundamental principles of enzyme kinetics and the role of enzymes in bioprocess engineering.	K1
CO-2:	Explain the impact of pH and temperature on enzyme activity and stability in bioprocess applications.	K2
CO-3:	Perform spectrophotometric analysis to determine enzyme kinetic parameters, including Vmax and Km.	K3
CO-4:	Experimentally evaluate the effects of different types of enzyme inhibitors (competitive, uncompetitive, noncompetitive) on enzymatic reactions.	K3
CO-5:	Compare isozyme activity through specific assays to understand their functional differences and significance in bioprocess applications.	K4
CO-6:	Interpret experimental data to assess enzyme behavior under different environmental conditions and optimize enzyme usage in industrial processes.	K4

COURSE CONTENT:

Experiment Number	Title	Duration
1	Determination of enzyme kinetic parameters by spectrophotometric method	60 Hours
2	Demonstration of effect of pH and temperature on enzyme activity	
3	Study of inhibitors on enzymatic activity (competitive, uncompetitive, non-competitive)	
4	Isozyme Assays	
5	Isolation of bioactive compounds from plant sources and their separation using standard techniques.	

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. in Biotechnology	**Year, Semester: 2nd Yr., 3rd Sem**
Course Title: Project - I	**Subject Code: TIU-PBT-P297**
Contact Hours/Week: 0-0-10 (L–T–P)	**Credit: 5**

COURSE OBJECTIVE:

Enable the student to:

1. Develop practical skills in prototype design, execution, testing, and iterative improvement.
2. Understand the fundamentals of structuring a scientific startup, including business strategy and project execution.
3. Enhance collaboration and teamwork skills for efficient project management and decision-making.
4. Gain problem-solving abilities to tackle execution challenges in research and innovation.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Apply engineering and scientific principles to design, develop, and refine functional prototypes.	K1
CO-2	Demonstrate an understanding of business strategy by structuring a startup idea and defining execution plans.	K2
CO-3	Exhibit teamwork and leadership skills in project execution, team roles, and decision-making.	K3
CO-4	Solve real-world execution challenges through strategic planning and iterative improvements.	K4
CO-5	Demonstrate Literature Review and Proposal Writing	K4
CO-6	Demonstrate Report Writing and Presentation	K3

Course content

Module	Course Content	Contact Hours
Module 1	Project Orientation and Topic Finalization • Introduction to research methodology • Selection of research area and project supervisor • Framing research objectives & hypothesis	20 Hours
Module 2	Literature Review and Proposal Writing • Review of relevant scientific literature • Research proposal formulation • Identification of research gap and justification	20 Hours
Module 3	Experimental Design and Methodology • Selection of tools, techniques, and protocols • Designing experiments and data collection strategy • Laboratory work initiation	30 Hours
Module 4	Data Collection and Analysis • Execution of experiments • Recording observations and troubleshooting • Statistical analysis of data and result interpretation	30 Hours
Module 5	Report Writing and Presentation • Structuring the mini-thesis: Abstract, Introduction, Methodology, Results, Discussion, Conclusion, References • Preparation for viva & defense	20 Hours
Total		120 Hours

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. in Biotechnology	**Year, Semester:** 2nd Yr., 3rd Sem
Course Title: Entrepreneurship Skill Development	**Subject Code:** TIU-PES-S299
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Develop practical skills in prototype design, execution, testing, and iterative improvement.
2. Understand the fundamentals of structuring a scientific startup, including business strategy and project execution.
3. Enhance collaboration and teamwork skills for efficient project management and decision-making.
4. Gain problem-solving abilities to tackle execution challenges in research and innovation.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Apply engineering and scientific principles to design, develop, and refine functional prototypes.	K1
CO-2	Demonstrate an understanding of business strategy by structuring a startup idea and defining execution plans.	K2
CO-3	Exhibit teamwork and leadership skills in project execution, team roles, and decision-making.	K2
CO-4	Solve real-world execution challenges through strategic planning and iterative improvements.	K3
CO-5	Structuring a Scientific Startup: Team Roles, Responsibilities, Project Management.	K4
CO-6	Analyzing strategies for overcoming challenges.	K4

COURSE CONTENT:

MODULE 1:	**EXECUTION AND PROTOTYPE DEVELOPMENT**	**10 Hours**
Designing and building a functional model of the solution. Testing and refining based on performance. Documenting findings and improvements.		
MODULE 2:	**BUSINESS STRATEGY AND TEAM COLLABORATION**	**20 Hours**
Basics of structuring a scientific startup idea. Team roles, responsibilities, and project management. Overcoming challenges in execution and decision-making.		
TOTAL LECTURES		**30 Hours****

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. in Biotech	**Year, Semester:** 2nd Yr., 3rd Sem
Course Title: Skill Development -III	**Subject Code:**TIU-PBT-PS201
Contact Hours/Week: 2–0-0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Master fundamental molecular biology techniques, including DNA/RNA isolation, PCR, and electrophoresis.
2. Develop technical expertise in cloning, vector manipulation, and transformation methods.
3. Understand blotting and hybridization techniques for molecular analysis and detection.
4. Integrate theoretical knowledge with practical skills to troubleshoot experiments and explore career pathways in molecular biology.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Perform DNA and RNA isolation from various biological sources with quality assessment techniques.	K1
CO-2	Apply electrophoresis techniques for nucleic acid analysis and documentation.	K2
CO-3	Utilize PCR-based methods, including conventional and quantitative PCR, for DNA amplification and detection.	K3
CO-4	Execute molecular cloning techniques, including restriction digestion, ligation, and transformation, for genetic engineering applications.	K4
CO-5	Analyze blotting and Hybridization techniques.	K4
CO-6	Apply lab safety and documentation techniques for research.	K4

Course content:

Module	Course Content	Contact Hours
Module 1	DNA & RNA Isolation Techniques • Genomic DNA isolation from bacteria, plant, and animal cells • RNA extraction and quality assessment (spectrophotometry, gel electrophoresis) • Plasmid DNA isolation (miniprep, maxiprep)	30 HOURS
Module 2	Gel Electrophoresis and Visualization • Agarose gel electrophoresis of nucleic acids • Polyacrylamide gel electrophoresis (PAGE) • Use of DNA ladders and molecular markers • Safe staining & gel documentation	
Module 3	Polymerase Chain Reaction (PCR) • Conventional PCR: Primer design, amplification protocols • RT-PCR: cDNA synthesis and amplification • qPCR (overview and applications) • Troubleshooting PCR reactions	
Module 4	Cloning Techniques and Vectors • Restriction digestion • Ligation of DNA fragments • Use of plasmid vectors (pUC19, pBR322) • Competent cell preparation and bacterial transformation • Blue-white screening	
Module 5	Blotting and Hybridization Techniques • Southern and Northern blotting principles • Probe preparation (radioactive and non-radioactive) • Hybridization, washing, and detection methods	
Module 6	Applications and Skill Integration • Troubleshooting molecular experiments • Career pathways in molecular biology • Lab safety and documentation protocols	
Total		30 Hours

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: M.Sc. in Biotechnology	**Year, Semester: 2nd Yr., 4th Sem**
Course Title: Project work	**Subject Code: TIU-PBT-P294**
Contact Hours/Week: 0–0–20 (L–T–P)	**Credit: 20**

Enable the student to:

1. Understand the fundamental principles of research methodology and develop a structured approach to selecting research topics and framing hypotheses.[
2. Develop analytical skills by critically reviewing literature, identifying research gaps, and justifying research objectives.
3. Acquire hands-on experience in designing and executing experiments, data collection, and troubleshooting.
4. Enhance proficiency in statistical analysis, scientific writing, and research presentation for effective communication of findings.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Apply research methodology principles to select research topics, define objectives, and formulate hypotheses effectively.	K1
CO-2	Conduct a comprehensive literature review to identify research gaps and develop a justified research proposal.	K1
CO-3	Design and execute experiments using appropriate tools and methodologies, ensuring reliable data collection and analysis.	K2
CO-4	Analyze and interpret research findings, effectively presenting them through structured scientific reports and oral defense.	K3
CO-5	Analyse statistical analysis data and interpretation.	K4
CO-6	Perform a thorough literature review to identify research gaps and formulate a well-justified research proposal.	K4

Course Content:

Module	Course Content	Contact Hours
Module 1	Project Orientation and Topic Finalization • Introduction to research methodology • Selection of research area and project supervisor • Framing research objectives & hypothesis	
Module 2	Literature Review and Proposal Writing • Review of relevant scientific literature • Research proposal formulation • Identification of research gap and justification	
Module 3	Experimental Design and Methodology • Selection of tools, techniques, and protocols • Designing experiments and data collection strategy • Laboratory work initiation	
Module 4	Data Collection and Analysis • Execution of experiments • Recording observations and troubleshooting • Statistical analysis of data and result interpretation	
Module 5	Report Writing and Presentation • Structuring the mini-thesis: Abstract, Introduction, Methodology, Results, Discussion, Conclusion, References • Preparation for viva & defense	120 HOURS

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. in Biotechnology	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Career Advancement and Skill Development (Grand Viva)	**Subject Code:**TIU-PBT-S294
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to**:**

1. Develop career-oriented skills such as resume writing, professional networking, and workplace readiness to enhance employability.
2. Strengthen scientific and technical communication skills for effective research presentations, thesis defense, and public speaking.
3. Prepare for comprehensive assessments through syllabus-wide viva voce and subject-specific oral tests.
4. Cultivate interdisciplinary knowledge and critical thinking for industry readiness and academic excellence.

COURSE OUTCOMES

CO No.	Course Outcome	
CO-1	Demonstrate career readiness by effectively preparing resumes, cover letters, and professional networking profiles.	K1
CO-2	Apply scientific communication techniques to deliver structured research presentations and defend theses confidently.	K1
CO-3	Exhibit proficiency in subject-specific and interdisciplinary knowledge through comprehensive viva and oral assessments.	K2
CO-4	Integrate critical thinking and workplace dynamics to enhance professional and academic growth.	K3
CO-5	Analyze research presentation and techniques and thesis defense skills.	K3
CO-6	Demonstrate syllabus wise viva voce presentation.	K4

COURSE CONTENT:

MODULE	TOPIC	HOURS
MODULE 1:	Career Skills & Industry Readiness	90 HOURS
	Resume & CV writing, Cover letters and email etiquette, Personal branding (LinkedIn, networking), Interview skills – mock interviews, HR & technical, Workplace readiness: time management, team dynamics.	
MODULE 2:	Scientific and Technical Communication	
	Research presentation techniques (oral/poster), Thesis defense skills, Abstract writing & executive summaries, Presentation tools (PowerPoint, Prezi), Public speaking & articulation strategies.	
MODULE 3:	Grand Viva & Comprehensive Review	
	Syllabus-wide viva voce preparation, Subject-specific oral tests (core subjects & electives), Interdisciplinary and current affairs in biotechnology, Evaluation by internal & external examiners.	
	TOTAL LECTURES	90 Hours

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M.Sc. in Biotechnology	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Entrepreneurship Skill Development	**Subject Code:**TIU-PES-S298
Contact Hours/Week: 2–0-0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Develop practical skills in prototype design, execution, testing, and iterative improvement.
2. Understand the fundamentals of structuring a scientific startup, including business strategy and project execution.
3. Enhance collaboration and teamwork skills for efficient project management and decision-making.
4. Gain problem-solving abilities to tackle execution challenges in research and innovation.

COURSE OUTCOME:

CO No.	Course Outcome	
CO-1	Understanding prototype design principles, material selection, and feasibility assessment.	K1
CO-2	Developing the initial model, conducting performance tests, and analyzing results.	K1
CO-3	Improving the prototype based on test outcomes, documenting findings, and implementing enhancements.	K2
CO-4	Identifying market needs, defining value propositions, and setting business objectives.	K2
CO-5	Organizing an effective team, assigning roles, and applying agile project management methodologies.	K3
CO-6	Addressing technical and business obstacles, risk management, and strategic decision-making.	K4

COURSE CONTENT:

MODULE 1:	**EXECUTION AND PROTOTYPE DEVELOPMENT**	**15 Hours**
Designing and building a functional model of the solution. Testing and refining based on performance. Documenting findings and improvements.		
MODULE 2:	**BUSINESS STRATEGY AND TEAM COLLABORATION**	**15 Hours**
Basics of structuring a scientific startup idea. Team roles, responsibilities, and project management. Overcoming challenges in execution and decision-making.		
TOTAL LECTURES		**30 Hours****