TECHNO INDIA UNIVERSITY
WEST BENGAL

M.Tech. Biotechnology
AY 2024-25

SEMESTER I

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Plant and Animal Cell Technology	**Subject Code:TIU-PBT-T151**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental techniques of plant and animal cell culture.
2. Analyse different culture methods and their applications in biotechnology.
3. Develop skills in handling and maintaining plant and animal cell cultures for research and industrial applications.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the history, principles, and basic setup of plant and animal cell culture laboratories.	K2
CO-2	Demonstrate knowledge of different types of culture media, sterilization techniques, and growth conditions.	K2
CO-3	Analyze different plant and animal cell culture methods and their applications in biotechnology.	K4
CO-4	Apply tissue culture techniques for micropropagation, organogenesis, and somatic embryogenesis.	K3
CO-5	Utilize transgenic technology and stem cell research for biotechnological advancements.	K3
CO-6	Evaluate the significance of cell culture techniques in genetic engineering and pharmaceutical research.	K3

COURSE CONTENT:

MODULE 1:	**Basics of Plant Tissue Culture**	**8 Hours**
History of Tissue Culture technique, plant tissue culture lab setup - equipment, sterilization methods; Nutrient media: types, micronutrients, macronutrients, vitamins, composition of commonly used nutrient culture, defined and undefined media, growth regulators, surface sterilization. Dedifferentiation and redifferentiation in plant cells, totipotency.		
MODULE 2:	**Methods and Applications in Plant Tissue Culture**	**17 Hours**
Explant selection, micropropagation method and application, proliferation of axillary and apical bud, meristem culture, virus-free plants, callus culture - induction and regeneration, single-cell culture, suspension culture, cellular growth measurement and viability, culture synchronization, somatic embryogenesis, organogenesis, organ culture and embryo rescue, protoplast isolation, protoplast culture, and somatic hybridization, somatic embryogenesis, haploid and doubled haploid plant production, production of artificial seeds, cryopreservation, and germplasm conservation. Somaclonal variation in vitro cultured plants, molecular basis of somaclonal variation, hardening and greenhouse transfer of tissue culture-raised plants, importance of in-vitro propagation techniques in plant improvement.		
MODULE 3:	**Basics of Animal Cell Culture**	**16 Hours**
History of cell culture, Animal cell culture basic principles, Primary and secondary cell culture, Laboratory requirements for animal cell culture: Sterile handling area, Sterilization of different materials used in animal cell culture, Aseptic concepts, Instrumentation and equipment for animal cell culture, serum-free and serum-based media, scaling-up, characterization, and preservation of cell lines, cytotoxicity and viability assays. Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture, Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.		
MODULE 4:	**Methods and Applications of Animal Cell Culture**	**4 Hours**
Stem cells, micromanipulation of embryos, generation of modified stem cells, transgenic animals, knock-in and knock-out animals. Importance of transgenic animals in biotechnology and ethical issues.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Bioprocess Engineering and separation Technology	**Subject Code:TIU-PBT-T153**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

1. This course aims to provide an in-depth understanding of bioprocess engineering principles, bioreactor design, microbial and cell culture techniques, and downstream processing methods.
2. The course will emphasize the industrial applications of bioprocess engineering and process scale-up strategies.

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand enzyme immobilization techniques and mass transfer considerations.	K2
CO-2	Analyze microbial growth kinetics and stoichiometry in bioprocesses.	K4
CO-3	Evaluate different downstream processing techniques for product recovery and purification.	K4
CO-4	Apply principles of bioreactor operation, sterilization, and aeration in industrial processes.	K3
CO-5	Develop bioprocess strategies for industrial-scale production and scale-up.	K3
CO-6	Implement cost-effective and optimized methods for downstream processing and product recovery.	K3

COURSE CONTENT:

MODULE 1:	**Immobilized Enzymes and Industrial Enzymes**	**5 Hours**
Immobilized enzymes: methods, mass transfer considerations; Industrial enzymes.		
MODULE 2:	**Microbial Growth and Kinetics**	**5 Hours**
Microbial growth: Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.		
MODULE 3:	**Bioreactors and Fermentation Processes**	**9 Hours**
Bioreactors: Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/mammalian cell culture reactors. Bioseparations: Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography Industrial Processes and Process economics: Description of industrial processes; Process flow sheeting; Process economics. Bioreactor design and operation: classification of reactors; Ideal mixed v/s plug flow reactor; designing parameters for reactors (stirred tank reactor, airlift reactor, plug flow reactor), rheology of fermentation broth, Bioreactor design and operation: gas-liquid mass transfer, heat transfer, analysis of dimension less parameters and their application (aeration number, power number and Reynold's number; Scale-up of bioprocesses: parameters used in scale-up and problems associated with scale-up.		
MODULE 4:	**Bioseparations and Downstream Processing**	**10 Hours**
Engineering principle of bio processing- Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms. Downstream Processing: Biomass removal and disruption; Centrifugation; sedimentation; Flocculation; Microfiltration; Sonication; Bead mills; Homogenizers; Chemical lysis; Enzymatic lysis; Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ; Diafiltration ; Pervaporation; Perstraction; Adsorption and chromatography: size, charge, shape, hydrophobic interactions, Biological affinity; Process configurations (packed bed, expanded bed, simulated moving beds); Precipitation (Ammonium Sulfate, solvent); Electrophoresis(capillary); Crystallization; Extraction (solvent, aqueous two phase, super critical), Drying; Case studies		
MODULE 5:	**Advanced Downstream Processing**	**16 Hours**
Solid- Liquid separation techniques; Cross flow & End Flow Filtration, Centrifugation: Analytical and Preparative Ultracentrifugation; Different types: Density gradient, Isopycnic; Rate zonal centrifugation etc. Cell Disruption Process for intracellular product separation, Removal of insoluble's, biomass (particulate debris), Flocculation, Sedimentation, Centrifugation etc. Membrane based separation (MF and UF) theory,		

Procedure and Application. Microfiltration, Ultrafiltration, and Reverse Osmosis Precipitation Methods: - Salting in and salting out. Aqueous two-phase extraction and in situ product removal. 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 androtary dryer, Freeze dryer and Spray dryer, Packaging and Quality Assurance, Economics and downstream processing in BT: Cost cutting strategies, Optimal methods of product recovery (efficacy and cost effectiveness).	
TOTAL LECTURES	**45 Hours**

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WEST BENGAL

Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Food, Nutrition and Toxicology	**Subject Code:TIU-PBT-155**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental concepts of nutraceuticals, food nutrition, and toxicology.
2. Analyze the biochemical significance of carbohydrates, lipids, proteins, and enzymes in human nutrition.
3. Explore the role of essential nutrients, dietary components, and their metabolic pathways in health and disease.
4. Identify naturally occurring food toxicants, food adulteration practices, and regulatory food laws.
5. Examine the significance of fermented foods, prebiotics, probiotics, postbiotics, and antioxidants in human health.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the biochemical and nutritional significance of carbohydrates, lipids, and proteins in the human diet.	K2
CO-2	Assess the metabolic pathways of macronutrients, enzymatic activity, and related metabolic disorders.	K2
CO-3	Investigate the role of dietary fiber, essential fatty acids, and food constituents in health and disease prevention.	K4
CO-4	Identify and analyze food toxicants, their physiological effects, and food safety regulations.	K3
CO-5	Evaluate the impact of food adulteration and food laws (HACCP, FSSAI, ISO-17025) on consumer safety.	K3
CO-6	Explore the significance of fermented foods, probiotics, prebiotics, postbiotics, and antioxidants in maintaining gut health.	K3

COURSE CONTENTS:

MODULE 1:		**7 Hours**
The concept of nutraceuticals (therapeutic diets) - a brief account. Nutritional significance of carbohydrates, lipids - chemistry, metabolism, absorption - dietary source and functional properties. Nutritional requirements. Role of dietary fibre, role of essential fatty acids, cis-trans isomerism and enzymatic conversions of fatty acid, deficiency and excess of fat - role of fats in atherosclerosis. Role of these constituents in food industry. Naturally occurring food toxicants in food grains - haemaglutinins, goitrogens, lathyrogens, and naturally occurring carcinogens: their physiological role. Food additives - colorants, flavour - producing agents and their identification.		
MODULE 2:		**7 Hours**
Protein: structural and functional characteristics: amino acid, biochemical structure, and their role in nutrition (essential and non essential amino acids). Qualitative and quantitative determination of amino acid in food products, metabolic diseases (alkaptanuria, phenylketonuria, mapple syrup urine diseases, albinism) 1d, 2d, 3d, 4d structure of protein, peptide bond, Ramachandran plot, solubility of protein, protein digestion, protein deficiency diseases.		
MODULE 3:		**6 Hours**
Enzyme: classfication, michaelismenten equation, protein metabolism, urea cycle, related disease. Food browning, role of po, ppo Fermented food, prebiotics, probiotics, postbiotics, their importance, gut microbiome. Plant secondary metabolites and antioxidant. Food adulteration and different food laws (haccap etc), fassai, iso-17025.		
MODULE 4:		**25 Hours**
Analysis of oligosacharides from food samples; solvent extraction method for the estimation of oil content - by soxhlet method; estimation of cholesterol; determination of saponification number; chromatographic separation of sugars; extraction and estimation of total free phenols; extraction and estimation of lycopene		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Biochemistry	**Subject Code:TIU-PBT-E151**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental biochemical principles, including **water chemistry, pH, buffers, and osmotic balance**.
2. Analyze the **structural and functional aspects of biomolecules** such as carbohydrates, proteins, lipids, nucleic acids, vitamins, and hormones.
3. Explore the **organization and properties of biological membranes, membrane fluidity, and transport mechanisms**.
4. Examine the **role of antioxidants, redox signaling, oxidative stress-related diseases, and medicinal foods**.
5. Investigate the **structural and functional characteristics of key biomolecules**, including hemoglobin, myoglobin, and chlorophyll.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the biochemical properties of water, pH, buffers, and their role in biological systems.	K2
CO-2	Describe the structure and function of cell membranes and membrane transport mechanisms.	K2
CO-3	Analyze the structural and functional significance of carbohydrates, proteins, lipids, nucleic acids, vitamins, and hormones.	K4
CO-4	Evaluate the role of hemoglobin, myoglobin, and chlorophyll in biological systems.	K3
CO-5	Assess the impact of oxidative stress, redox signaling, and antioxidants in disease prevention.	K3
CO-6	Explore the significance of medicinal foods and their role in maintaining health..	K3

COURSE CONTENTS:

MODULE 1:		**11 Hours**
Water as universal solvent, pH, Buffer, Blood Buffer, colloidal solution, osmosis and its Maintenance, Solution (Normality, Molarity etc.).		
MODULE 2:		**3 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:		**21 Hours**
Antioxidant and Redox Signaling, Oxidative stress related disease, Medicinal foods.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Advanced Bioanalytical techniques-I	**Subject Code:TIU-PBT-L151**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 4**

COURSE OBJECTIVE:

Enable the student to:

1. Develop proficiency in **bioanalytical techniques** for biomolecule separation, identification, and characterization.
2. Gain hands-on experience in **chromatography, electrophoresis, and molecular biology techniques**.
3. Explore **protein purification, enzymatic reactions, and immunological assays** in biochemical research.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Perform **ion exchange chromatography** for protein and biomolecule separation.	K3
CO-2	Conduct **2D gel electrophoresis** for protein profiling and analysis.	K3
CO-3	Isolate and transform **plasmid DNA** for genetic studies.	K4
CO-4	Purify **casein from milk** and analyze its biochemical properties.	K3
CO-5	Examine **enzymatic and non-enzymatic browning** reactions and their implications in food biochemistry.	K3
CO-6	Apply **immunoelectrophoresis** techniques for antigen-antibody	K3

COURSE CONTENTS:

MODULE 1:	**Ion Exchange Chromatography and 2D Gel Electrophoresis**	**15 Hours**
Ion Exchange Chromatography and 2D Gel Electrophoresis.		
MODULE 2:	**Plasmid Isolation and Protein Purification**	**15 Hours**
Plasmid Isolation, transformation, Purification of Casein from milk.		
MODULE 3:	**Enzymatic and Non-Enzymatic Browning**	**15 Hours**
Enzymatic and non-enzymatic browning.		
MODULE 4:	**Immunoelectrophoresis and Ouchterlony Double Diffusion**	**15 Hours**
TOTAL LECTURES		**60 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title: Grand Viva - I	**Subject Code:TIU-PBT-G151**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. **To integrate and consolidate knowledge** gained across all core and elective courses throughout the M.Sc. Biotechnology program through oral examination and critical discussion.

2. **To evaluate the student's conceptual understanding, analytical thinking, and problem-solving skills** in key areas of biotechnology such as molecular biology, genetics, biochemistry, cell biology, and applied research techniques.

3. **To develop confidence and communication skills** for presenting and defending scientific viewpoints clearly and logically during viva-voce and technical interviews.

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Seminar - I	**Subject Code:TIU-PBT-S151**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. **To enable students to explore, analyze, and present recent scientific developments** and emerging trends in various domains of biotechnology through literature review and presentations.

2. **To develop critical thinking, scientific communication, and presentation skills** by engaging in peer discussions and expert feedback sessions.

3. **To enhance students' ability to critically evaluate scientific literature** and understand the methodologies, data interpretation, and significance of research findings.

4. **To foster independent learning and academic inquiry**, encouraging students to stay updated with contemporary biotechnology research and its applications.

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Bioentrepreneurship - I	**Subject Code:TIU-PBT-S153**
Contact Hours/Week: **L-T-P: 2-0-0**	**Credit: 2**

Course Objectives:

1. To introduce students to the fundamentals of bioentrepreneurship and its relevance in the biotechnology industry.
2. To develop skills for identifying business opportunities and preparing business plans in the biotech sector.
3. To familiarize students with the regulatory landscape and IPR management in biotechnology.
4. To enable students to understand the funding mechanisms and commercialization strategies for biotech innovations.

Course Outcomes:

CO Numbers	**Course Outcomes**	Knowledge levels
CO1	CO1: Understand the basic concepts and scope of bioentrepreneurship. (K1)	K1
CO2	CO2: Analyze market needs and develop business models for biotechnology ventures. (K3)	K3
CO3	CO3: Formulate detailed business plans including financial and operational aspects. (K4)	K4
CO4	CO4: Identify and interpret relevant regulatory and IPR frameworks in the Indian context. (K2)	K2

CO5	CO5: Evaluate funding options and apply for startup support programs. (K4)	K4
CO6	CO6: Design commercialization strategies and assess market viability of biotech innovations. (K4)	K4

Course Contents

Module	**Title**	**Course Content**	**Hours**
Module 1	Introduction to Bioentrepreneurship	Definition and scope of bioentrepreneurship; Role of biotechnology in entrepreneurship; Characteristics of a successful entrepreneur; Case studies of biotech startups in India.	8
Module 2	Business Planning and Development	Idea generation and feasibility analysis; Components of a business plan; Market analysis and business model development; SWOT analysis.	8
Module 3	Regulatory and IPR Aspects	Overview of regulatory environment in India (FSSAI, DBT, CDSCO); Basics of intellectual property rights (IPR) – patents, copyrights, trademarks; Patent filing process and technology transfer.	7
Module 4	Funding and Commercialization	Sources of funding – government grants, venture capital, angel investors; Commercialization strategies for biotech products; Public-private partnerships; Incubation and startup support schemes.	7
Total			30 Hours

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SEMESTER II

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Proteomics, Genomics, and Bioinformatics	**Subject Code:TIU-PBT-T152**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles of **genomics, proteomics, and bioinformatics**, including gene and protein analysis techniques.
2. Gain knowledge of **genome sequencing, transcriptomics, and protein characterization** methods.
3. Develop proficiency in using **bioinformatics tools and databases** for genomic and proteomic research.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Analyze genomic features, gene prediction, and genome-wide association studies (GWAS).	K3
CO-2	Utilize functional genomics techniques to assign gene functions and identify genetic traits.	K3
CO-3	Perform transcriptome analysis, including microarray and RNA sequencing data interpretation.	K4
CO-4	Explain proteomics workflows, including 2D electrophoresis and mass spectrometry (MALDI-TOF, MS/MS).	K3
CO-5	Investigate post-translational modifications and protein interaction networks.	K4
CO-6	Apply bioinformatics tools and databases for genome and proteome research.	K3

Course content

MODULE 1:	GENOMICS:	21 Hours

Genomics: Gene and Genome analysis-Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; Gene prediction in prokaryotes and eukaryotes - Genome-wide association (GWA) analysis -Massively parallel Signature sequencing (MPSS), Whole genome Shotgun sequencing, Next Generation Sequencing (NGS) - Cytogenetic and physical mapping - GDB, NCBI, OMIM, NGI/MGD - Structural annotation - Functional annotation - Limitation of genomics Genome sequencing projects

Functional Genomics- Application of sequence based and structure-based approaches to assignment of gene functions – e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc.

Transcriptome Analysis, Applications of Genomics: Genomic medicine - Synthetic biology and bioengineering - Conservation genomics

MODULE 2:	Proteomics:	13 Hours

Protein chemistry to proteomics: The proteomics workflow,

Two-dimensional electrophoresis (2-DE), Advancement in solubilization of hydrophobic proteins, development of immobilized pH gradient strips, gel casting, staining of gels and image analysis. Two-dimensional fluorescence difference in-gel electrophoresis (DIGE), Blue native PAGE (BN-PAGE), gel free proteomics methods.

Protein MS applications – identifying unknown proteins by peptide mass fingerprinting; de novo sequencing of peptides from fragment ion spectra obtained by tandem MS. ESI-TOF, MALDI-TOF,MS/MS Post-translational modifications of proteins - Limitation of proteomics

Interaction proteomics - Protein networks - Expression proteomics

MODULE 3:	BIOINFORMATICS	11 Hours

Module 1: Biological databases, Biological data sciences in genome research

Module 2: Human Genome Project, Microarray Technology

Module 3: Bioinformatics for Proteomics, Principles of protein structure, Torsion angles and Ramachandran Plot

Module 4: Ontologies and clustering

Module 5: System Biology and biological network

TOTAL LECTURES	45 Hours

TECHNO INDIA UNIVERSITY
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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Medical Biotechnology and Therapeutics	**Subject Code:TIU-PBT-T154**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand **human physiology, disease mechanisms, and pharmacological principles** related to medical biotechnology.
2. Learn **molecular diagnostics and therapeutic strategies**, including gene therapy and stem cell therapy.
3. Explore **stem cell biology, differentiation, and regenerative medicine** for medical applications.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the **principles of human physiology, disease classification, and pharmacological concepts**.	K2
CO-2	Understand **drug administration, pharmacokinetics, and pharmacodynamics**.	K3
CO-3	Apply **molecular diagnostic techniques** like PCR, microarrays, and FACS in disease detection.	K4
CO-4	Evaluate **molecular and cellular therapies**, including gene therapy, enzyme therapy, and monoclonal antibody therapy.	K4
CO-5	Explain **stem cell biology, differentiation pathways, and their regulatory mechanisms**.	K3
CO-6	Analyze**the role of stem cells in tissue regeneration and therapeutic applications**.	K4

COURSE CONTENTS:

MODULE 1:	**An Introduction to Medical Biotechnology& Pharmacology:**	**7 Hours**
Biotechnology and health care; Basic human physiology; Definition of disease and its types: Genetic disease, Metabolic disease, Immune system malfunction and disease, Hormonal disease, Vitamin and minerals deficiency diseases. General Pharmacological Principle; Definition, Routes of drug administration; Pharmacokinetics, Pharmacodynamics. Molecular diagnostic – PCR based detection, Microarray and FACS		
MODULE 2:	**Invasive Technique:**	**7 Hours**
Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques -Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood.		
MODULE 3:	**Molecular therapy:**	**7 Hours**
DNA based vaccine, RNA based therapeutics, Antisense therapeutics; Enzyme therapy; Hormone therapy; Cytokine therapy; Monoclonal Antibody therapy. An introduction to stem cell therapy and regenerative medicine		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Molecular Biology	**Subject Code:TIU-PBT-E152**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the **molecular mechanisms of DNA replication, repair, recombination, transcription, and translation** in prokaryotic and eukaryotic systems.
2. Explore **gene regulation, chromatin structure, and intracellular organelle functions** in cellular processes.
3. Analyze the **structural organization of genes and chromosomes**, including operons, transposons, and chromatin modifications.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain DNA replication, repair mechanisms, and recombination in prokaryotes and eukaryotes.	K2
CO-2	Describe RNA synthesis, processing, and transport, including splicing and polyadenylation.	K3
CO-3	Analyze protein synthesis and post-translational modifications in gene expression.	K4
CO-4	Compare gene regulation mechanisms at the transcriptional and translational levels.	K3
CO-5	Explain the structural organization and functions of intracellular organelles.	K2
CO-6	Evaluate the organization of genes and chromosomes, chromatin structure, and mobile genetic elements..	K4

COURSE CONTENTS

MODULE 1:	**Introduction**	**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**	**9 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 of Organelle**	**4 Hours**
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 4:	**Organization of Genes and Chromosomes**	**17 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
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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Molecular Immunology-I	**Subject Code:** TIU-PBT-E154
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand **immune signal transduction, endocytosis, and cell motility** in the immune response.
2. Explore **cellular communication in immunity, including adhesion molecules and cytokines**.
3. Analyze**immune responses in tumor immunity, host-parasite interactions, and diagnostic applications**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain **immune signal transduction pathways and immune cell motility**.	K2
CO-2	Describe **communication between immune cells, cytokine functions, and adhesion molecules**.	K3
CO-3	Analyze**immune responses in tumor immunity and host-parasite interactions**.	K4
CO-4	Evaluate **the role of cell signaling in current immunodiagnostics and treatments**.	K4
CO-5	Interpret **the molecular basis of immune system regulation and dysfunction**.	K5
CO-6	Apply **advanced immunological techniques for disease diagnosis and therapy**.	K5

COURSE CONTENTS

MODULE 1:	**Immune Signal Transduction and Cell Motility**	**7 Hours**
Immune signal transduction, Immune endocytosis, Immune cell motility, Cell stress response		
MODULE 2:	**Communication in the Immune System**	**10 Hours**
Communication between cells of immune systems, adhesion molecules, cytokines.		
MODULE 3:	**Immunity Against Tumors and Host-Parasite Interactions**	**11 Hours**
Immunity against tumors, host-parasite interactions.		
MODULE 4:	**Cell Signaling in Diagnostics and Therapy**	**17 Hours**
Cell signaling in current diagnostics and treatment.		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Recombinant DNA and Protein Engineering-I	**Subject Code:** TIU-PBT-E158
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand **protein structure, stability, folding mechanisms, and associated diseases**.
2. Explore **protein engineering techniques, including mutagenesis, recombinant expression, and industrial applications**.
3. Analyze**proteomics approaches for protein identification, biomarker discovery, and drug development**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the fundamentals of protein structure, stability, and folding mechanisms.	K2
CO-2	Identify techniques for studying protein folding, structure determination, and molecular chaperones.	K3
CO-3	Apply protein engineering strategies, including mutagenesis and recombinant protein expression.	K4
CO-4	Evaluate protein-ligand interactions and structure-function relationships in engineered proteins.	K5
CO-5	Utilize proteomics techniques such as 2D-PAGE, mass spectrometry, and biomarker discovery.	K5
CO-6	Assess the role of proteomics in drug development, disease diagnosis, and therapeutic advancements.	K6

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COURSE CONTENT

MODULE 1:	**Protein Stability & Folding**	**15 Hours**
Protein stability and folding: Overview of protein structure, Higher level structure, Protein stability, Mechanism of protein folding, Folding Rate, Molten globule; Techniques for studying of protein folding;: NMR, CD spectroscopy, Proteolysis; Location and functions of Molecular chaperones, chaperonin and co-chaperons, Proteasomes and proteosome mediated protein degradation; Protein folding errors: Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and cancer. Determination of secondary structure- UV, CD and fluorescence Determination of quaternary structure - X-ray, Cryo TEM; Functional proteins - Hemoglobin and some well characterized enzymes / lectins / peptide hormons; Chemical modifications		
MODULE 2:	**Protein Engineering**	**12 Hours**
Protein engineering: Introduction to steps of Protein design and Engineering, protein splicing and its application; Production of Novel Proteins; Random and site directed mutagenesis, Methods for Expressing Recombinant Proteins; Industrial applications of Protein Engineering (Engineering of Stability, affinity for substrate, Protease Specificity, Cofactor requirements of Protein). Structure-function correlations in the context of protein ligand interactions & protein protein/nucleic acid/carbohydrate interactions.		
MODULE 3:	**Proteomics**	**18 Hours**
Proteomics: Introduction to proteomics; Two dimensional electrophoresis (2-D PAGE): Protein pre-fractionation and sample preparation, IEF, SDS-PAGE, visualization of protein spot. Protein identification by mass spectrometry: ESI-TOF, MALDI-TOF, MS/MS, PMF, protein sequencing; Post translational modification, Application of proteome analysis; Proteomics in Drug Development; Diagnosis of diseases by Proteomics; Protein array; Discovery of new biomarker; identification of protein-protein interactions and protein complexes; proteomics in drug delivery**.**		
TOTAL LECTURES		**45 Hours**

TECHNO INDIA UNIVERSITY
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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Nanotechnology and Nanotherapeutics-I	**Subject Code:** TIU-PBT-E156
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental principles of nanoscience, nanotechnology, and different types of nanoparticles.
2. Explore the synthesis, characterization, and stability of nanoparticles using advanced techniques.
3. Analyze the biomedical applications of nanotechnology, including nanomedicine, biosensors, and nanotoxicity.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the principles of nanoscience, types of nanoparticles, and their unique properties.	K2
CO-2	Describe the methods of nanoparticle synthesis, characterization techniques, and stability assessment.	K3
CO-3	Analyze naturally occurring bio-nanoparticles, molecular motors, and ion channels as molecular switches.	K4
CO-4	Evaluate nanomedicine applications, including drug delivery systems, smart drugs, and biosensors.	K4
CO-5	Interpret the impact of nanotechnology in medicine and assess potential nanotoxicity risks.	K5
CO-6	Apply nanotechnology-based tools for biomedical research, diagnostics, and therapeutic innovations.	K5

COURSE CONTENT

MODULE 1:	**Introduction**	**10 Hours**
Introduction to Nanoscience and nanotechnology; Solid State Chemistry and Band Theory; Concept of 3D, 2D, 1D and 0D nano particles. , Different important types of nanoparticles: Quantum Dot, Nanowire, Nanotube, Nano-cage, Buckminster fullerene (60) etc. Special Properties of Nanoparticles and its differences from bulk mater. Application of Nanomaterials.		
MODULE 2:	**Synthesis & Characterization**	**12 Hours**
Synthesis and characterization of nanoparticles and nano-structured machinery: Top-Down and Bottom-Up Approach: Physical, Chemical, Green synthesis of Nanoparticles. Characterization of Nanoparticles: UV-VIS Spectroscopy, DLS, FTIR, XRD, TEM, SEM, SPM (Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM)). Stability of Nanoparticle and ZETA Potential		
MODULE 3:	**Bio-nanotechnology**	**6 Hours**
Introduction to Bio-nanotechnology, naturally found nanoparticles, Molecular motors: natural molecular motors like myosin, kinesin, dynein, flagella, ATP synthase, RNA and DNA helicases, topoisomerases etc. Ion channels as molecular switches.		
MODULE 4:	**Nanomedicine & Applications**	**17 Hours**
Introduction to Nanomedicine, Application of Nanomedicine; Biosensors; Biodegradeable nanoparticles for drug and gene delivery to cells and tissues: liposome, dendrimer, gold nano particle, silver nano particle. Smart Drugs, DNA based nano devices, Nanorobotics, Nanomedical Diagnosis and treatment. Nanotoxicity.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Plant Molecular Biology, and Biotechnology-I	**Subject Code:** TIU-PBT-E160
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the **fundamentals of plant molecular biology, genetic engineering, and transformation techniques**.
2. Explore **plant tissue culture techniques** and their role in **biotic and abiotic stress resistance**.
3. Apply **molecular markers and genomic tools** for **genotyping, diversity analysis, and crop improvement**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the **fundamental concepts of plant genes, genomes, and gene cloning techniques**.	K2
CO-2	Demonstrate **various plant transformation methods**, including Agrobacterium-mediated gene transfer.	K2
CO-3	Analyze**genetic engineering strategies for biotic and abiotic stress resistance** in plants.	K4
CO-4	Apply **plant tissue culture techniques**, including somatic embryogenesis and micropropagation.	K3
CO-5	Utilize **molecular markers (RFLP, RAPD, SNP, AFLP) for plant genotyping and diversity analysis**.	K3
CO-6	Interpret **modern genomic tools such as RNA sequencing and microarray analysis** for plant biotechnology.	K3

COURSE CONTENT

MODULE 1:	**Plant Genes and Genetic Transformation**	**10 Hours**
Introduction to Plant genes and genome. Gene cloning, Genetic engineering techniques, - DNA, RNA and Protein blotting, Basics of gene cloning, identification and selection of recombinants, Vector construction, First strand cDNA synthesis, PCR Primer designing, Semi-quantitative RTPCR, Quantitative Real time PCR (qPCR), Microarray and RNAseq analysis. Genetic Transformation -- Various transformation methods; Agrobacterium-mediated gene delivery; T-DNA transfer; Disarming the Ti plasmid; Vector designing; Screenable and selectable markers; Chloroplast transformation Plant expression vectors.		
MODULE 2:	**Stress Resistance and Quality Improvement**	**10 Hours**
Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance -- Viral resistance; Fungal resistance; Insects and pathogens resistance; Drought, salinity, thermal stress, flooding and submergence tolerance. · Genetic Engineering for Quality Improvement and Other Traits -- Post-harvest bioengineering; Concept of biofactories; Herbicide resistance; Phytoremediation; Nutraceuticals; Molecular means of heterosis breeding.		
MODULE 3:	**Plant Tissue Culture**	**10 Hours**
Plant Tissue Culture - somatic embryogenesis; Artificial seed production; Micropropagation; Soma clonal variation; Androgenesis; Germplasm conservation and cryopreservation; Protoplast Culture and somatic hybridization.		
MODULE 4:	**Genomic Tools and Molecular Markers**	**15 Hours**
Genomic and EST markers, Molecular markers in genotyping, diversity analysis and population differentiation. Plant Molecular markers, Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: GLYCOBIOLOGY AND ALLIED DISEASES-I	**Subject Code:** TIU-PBT-E162
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the **structural diversity and functional significance of carbohydrates** in biological systems.
2. Explore **glycosylation mechanisms, carbohydrate-processing enzymes, and their roles in health and disease**.
3. Analyze**glycan-related disorders and their implications in therapeutics and immunity**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Describe the **structural classification and biological roles of carbohydrates and glycoconjugates**.	K2
CO-2	Explain **the function of carbohydrate-active enzymes (CAZymes) in glycan metabolism**.	K2
CO-3	Investigate **the role of glycoproteins, proteoglycans, and glycolipids in cellular processes and diseases**.	K4
CO-4	Analyze**the importance of glycosylation in protein trafficking, immune response, and microbial interactions**.	K3
CO-5	Evaluate **the role of lectins and bacterial toxins in host-pathogen interactions**.	K3
CO-6	Interpret **the molecular basis of glycan-related diseases and therapeutic applications**.	K3

COURSE CONTENTS

MODULE 1:	**Carbohydrate Structure and CAZyme**	**10 Hours**
Carbohydrate structure- Simple, complex and conjugate. CAZyme structure/ function relationships Common sugars in plant, microbial and animals- Cell wall, structural glycans. Glycosides- Glycosyl transferases (GTs), Glycoside hydrolases and transglycosidases (GHs), Carbohydrate binding modules (CBMs), Polysaccharide lyases (PLs), Carbohydrate esterases (CEs) Glycoproteins Vs Proteoglycans, N- and O-linked glycans		
MODULE 2:	**Cellular Trafficking and Glycolipids**	**15 Hours**
Cellular membrane trafficking and trafficking of N-glycoproteins, O-Linked glycosylation, Mucins and Mucin type glycoproteins Glycolipids- Glycosphingolipids and associated diseases, Lignin- Carbohydrate complex.		
MODULE 3:	**Enzymes and Bioethanol Production**	**10 Hours**
Lipid rafts, Cellulases, Xylanases, Amylases, Xyloglucanases, Xyloglucan endo-transglycosylases. Sucrose bioethanol, starch bioethanol, lignocellulosic bioethanol Roles in protein trafficking,		
MODULE 4:	**Lectins, Toxins, and Glycan Diseases**	**10 Hours**
innate immunity, therapeutic glycoprotein clearance Lectins- Toxicity and applications of plant lectins, Lectins as microbial toxins and bacterial adhesion molecules Influenza - hemagglutinins and neuraminidases, Fabry and Schindler diseases, Blood groups and blood group interconversion		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Advanced Bioanalytical Techniques-II	**Subject Code:** TIU-PBT-L152
Contact Hours/Week: **L-T-P 0-0-4**	**Credit: 4**

COURSE OBJECTIVE:

Enable the student to:

1. Develop **proficiency in advanced bioanalytical techniques for biomolecular analysis**.
2. Gain **hands-on experience in protein characterization, nucleic acid analysis, and immunoassays**.
3. Apply **bioanalytical methods in biomedical and biotechnological research**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Perform ELISA for antigen-antibody interaction analysis.	K2
CO-2	Analyze protein unfolding using tryptophan fluorescence spectroscopy.	K2
CO-3	Conduct blood grouping experiments to understand antigen-antibody specificity.	K3
CO-4	Execute SDS-PAGE and Size Exclusion Chromatography for protein separation and molecular weight estimation	K3
CO-5	Utilize HPTLC for high-resolution separation of biomolecules.	K3
CO-6	Implement Southern blotting techniques for DNA detection and hybridization studies.	K4

COURSE CONTENTS:

MODULE 1:	Ion Exchange Chromatography and 2D Gel Electrophoresis	**15 Hours**
Ion Exchange Chromatography and 2D Gel Electrophoresis.		
MODULE 2:	Plasmid Isolation and Protein Purification	**15 Hours**
Plasmid Isolation, transformation, Purification of Casein from milk.		
MODULE 3:	Enzymatic and Non-Enzymatic Browning	**15 Hours**
Enzymatic and non-enzymatic browning.		
MODULE 4:	Immunoelectrophoresis and Ouchterlony Double Diffusion	**15 Hours**
TOTAL LECTURES		**60 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Bioentrepreneurship - II	**Subject Code:**TIU-PBT-S154
Contact Hours/Week: **L-T-P: 2-0-0**	**Credit: 2**

Course Objectives:

1. To equip students with knowledge of regulatory frameworks and compliance relevant to biotech enterprises.
2. To develop understanding of financial planning, budgeting, and funding avenues for biotech ventures.
3. To provide insights into strategic commercialization and market entry of biotech products.

Course Outcomes:

CO No.	Course Outcomes	Knowledge Level
CO1	Demonstrate understanding of business planning and strategic decision-making in biotech startups.	**K2**
CO2	Explain regulatory compliance requirements applicable to biotech-based enterprises.	**K2**
CO3	Analyze different financial models and fundraising strategies for bio-ventures.	**K3**
CO4	Apply financial tools to manage biotech enterprise budgets and operations.	**K3**
CO5	Evaluate commercialization strategies for scaling up laboratory innovations.	**K4**
CO6	Design a biotech product launch roadmap including licensing and partnerships.	**K4**

Course content

Module	Title	Course Content	Hours
Module 1	**Advanced Business Planning and Strategy**	Writing and refining a business plan; SWOT analysis; Competitive landscape;	8
Module 2	**Regulatory Affairs and Compliance in Biotech**	Understanding biotech regulations; Regulatory bodies (CDSCO, DBT, FSSAI, etc.); IP protection; Bioethics and biosafety compliance.	8
Module 3	**Fundraising and Financial Management**	Sources of funding: venture capital, government grants; Financial statements; Budgeting; ROI and cost analysis.	7
Module 4	**Commercialization and Scale-up Strategies**	From lab to market; Tech transfer offices; Product launch strategies; Market analysis and penetration; Licensing and collaborations.	7
TOTAL			30 HOURS

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Project proposal submission & presentation	**Subject Code:T**IU-PBT-P152
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objective:

1. To introduce students to the fundamentals of research proposal writing.

2. To enable critical review of scientific literature for identifying research gaps.

3. To guide students in drafting structured and compelling research proposals.

4. To train students in effective scientific presentation techniques.

Course Outcomes:

CO Number	Course Outcomes	Knowledge Level
CO1	Understand the structure and purpose of a scientific research proposal.	K1
CO2	Conduct comprehensive literature reviews and identify research gaps.	K2
CO3	Formulate clear research objectives and hypotheses.	K3
CO4	Draft a well-organized and scientifically sound project proposal.	K4
CO5	Demonstrate proficiency in presenting scientific ideas using visual tools.	K3
CO6	Engage in peer feedback and refine proposals based on constructive critique.	K4

Course Content:

Module	Course Content	Contact Hours
Module 1: Introduction to Research Proposal Writing	Overview of research proposal components, importance of proposals in research, funding agency expectations, ethical considerations.	15
Module 2: Literature Review and Problem Identification	Techniques for comprehensive literature review, tools and databases, identifying gaps, defining problem statements and objectives.	15
Module 3: Proposal Drafting and Structuring	Structuring the proposal: title, abstract, introduction, methodology, budget, expected outcomes, timeline; writing styles and referencing.	15
Module 4: Presentation and Peer Review	Presentation skills development, use of visual aids, mock presentations, peer and faculty feedback sessions.	15
Total		60 HOURS

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Seminar - II	**Subject Code:TIU-PBT-S152**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. **To enable students to explore, analyze, and present recent scientific developments** and emerging trends in various domains of biotechnology through literature review and presentations.

2. **To develop critical thinking, scientific communication, and presentation skills** by engaging in peer discussions and expert feedback sessions.

3. **To enhance students' ability to critically evaluate scientific literature** and understand the methodologies, data interpretation, and significance of research findings.

4. **To foster independent learning and academic inquiry**, encouraging students to stay updated with contemporary biotechnology research and its applications.

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd** Yr., 3rd Sem.
Course Title: Plant Molecular Biology, and Biotechnology-II	**Subject Code:** TIU-PBT-P253B
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

- Gain an advanced understanding of plant genome organization and regulatory DNA elements relevant to gene expression and genetic engineering.
- Develop in-depth knowledge of cutting-edge gene editing tools such as CRISPR/Cas systems and their application in precise genome modification.
- Explore high throughput "omics" approaches (transcriptomics, proteomics, metabolomics) and systems biology for deciphering complex traits in plants.
- Understand advanced strategies and tools for efficient genetic transformation, including organellar transformation and synthetic biology applications.
- Examine translational plant biotechnology approaches for developing climate-resilient, nutrient-enriched crops and molecular farming applications.
- Evaluate biosafety regulations, ethical concerns, and global perspectives in deploying advanced plant biotechnologies.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand the structure of plant genomes and the function of regulatory DNA elements involved in gene expression and engineering.	K2
CO-2	Apply genome editing tools like CRISPR/Cas for targeted modification of plant traits and evaluate gene editing outcomes.	K3
CO-3	Analyze transcriptomic, proteomic, and metabolomic data to interpret gene function and regulatory networks in plants.	K4

CO-4	Demonstrate the design and application of advanced plant transformation strategies including synthetic biology and organelle genome engineering.	K3
CO-5	Evaluate molecular breeding techniques and genomic approaches for trait improvement in crops under stress and changing environments.	K5
CO-6	Assess the ethical, regulatory, and biosafety considerations in the development and deployment of genetically engineered and edited crops.	K5

COURSE CONTENT

MODULE 1:	**Advanced Gene Cloning and Expression Systems**	**9 Hours**
Overview of plant genome organization; Advanced gene cloning strategies; Promoters and regulatory elements (inducible, tissue-specific, synthetic promoters); Enhancers, silencers, insulators; Binary and ternary vector systems; Reporter genes.		
MODULE 2:	**Plant Genome Editing Technologies**	**10 Hours**
CRISPR/Cas systems (Cas9, Cas12, base and prime editing); CRISPR multiplexing; Gene knockout and knock-in strategies; Delivery methods for CRISPR components; Off-target effects and mitigation; Regulatory perspectives on genome-edited crops.		
MODULE 3:	**Omics and Systems Biology in Plants**	**9 Hours**
Transcriptomics (RNAseq analysis pipelines), Proteomics (2D-Gel, Mass Spec), Metabolomics, Interactomics; Data integration and network biology; Functional genomics; Systems biology approaches for trait improvement; Bioinformatics tools and databases.		
MODULE 4:	**Advanced Genetic Transformation and Applications**	**9 Hours**
Transformation efficiency enhancement strategies; Chloroplast and mitochondrial transformation; Marker-free transformation; Synthetic biology in plants; Transgene silencing and epigenetics; Precision trait stacking; Biosafety and bioethics.		
MODULE 5:	**Translational Plant Biotechnology**	**8 Hours**
Molecular breeding and speed breeding; Genome-wide association studies (GWAS); Genomic selection; Development of smart crops (climate-resilient, nutrient-rich); Plant-based production of biopharmaceuticals and vaccines; Case studies		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd** Yr., 3rd Sem.
Course Title: Environmental Biotechnology	**Subject Code:** TIU-PBT-P253F
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and applications of biotechnology in environmental management.
2. Explore microbial processes for pollution control and bioremediation.
3. Develop biotechnological strategies for sustainable development.
4. Analyze ethical and regulatory considerations in environmental biotechnology.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Demonstrate knowledge of microbial biotechnology for environmental applications.	K2
CO-2	Apply bioremediation and wastewater treatment techniques.	K3
CO-3	Utilize bioengineering tools for sustainable waste management.	K4
CO-4	Evaluate bioenergy production and environmental monitoring techniques.	K4
CO-5	Classify different Biosensors and pollution detection systems	K5
CO-6	Analyze regulatory frameworks and ethical concerns in environmental biotechnology.	K5

COURSE CONTENT

MODULE 1:	**Introduction to Environmental Biotechnology**	**8 Hours**
Environmental pollution, microbial interactions, biodegradation pathways.		
MODULE 2:	**Bioremediation and Waste Management**	**7 Hours**
Biodegradation of pollutants, phytoremediation, solid waste treatment.		
MODULE 3:	**Wastewater Treatment and Biofiltration**	**7 Hours**
Microbial treatment of industrial wastewater, biofiltration techniques.		
MODULE 4:	**Bioenergy and Biofuels**	**6 Hours**
Biogas, bioethanol, biodiesel production, microbial fuel cells.		
Module 5:	**Environmental Monitoring and Biosensors**	**5 Hours**
Biosensors for pollutant detection, bioreporters, bioindicators.		
Module 6:	**Ethical and Regulatory Aspects**	**12 Hours**
Environmental laws, biotechnology regulations, ethical concerns.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd** Yr., 3rd Sem.
Course Title: Bioinformatics	**Subject Code:** TIU-PBT-P253E
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand core computational techniques in bioinformatics.
2. Explore fundamental bioinformatics tools for genomics, proteomics, and systems biology.
3. Apply computational methods to analyze biological data.
4. Develop an understanding of regulatory and ethical aspects in bioinformatics research.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Demonstrate knowledge of sequencing techniques and bioinformatics tools.	K2
CO-2	Apply computational approaches to analyze genomic and proteomic data.	K3
CO-3	Utilize database management and sequence alignment techniques.	K4
CO-4	Evaluate molecular modeling and drug discovery applications.	K4
CO-5	Understand systems biology and network analysis.	K5
CO-6	Understand regulatory, ethical, and privacy aspects of bioinformatics.	K5

MODULE 1:	**Introduction to Bioinformatics**	**8 Hours**
Bioinformatics databases, sequence alignment, molecular phylogenetics.		
MODULE 2:	**Genomics and Proteomics**	**7 Hours**
Genome sequencing, transcriptomics, protein structure analysis.		
MODULE 3:	**Computational Tools and Data Analysis**	**7 Hours**
BLAST, FASTA, multiple sequence alignment, structural bioinformatics.		
MODULE 4:	**Molecular Modeling and Drug Discovery**	**6 Hours**
Molecular docking, homology modeling, structure-based drug design.		
Module 5:	**Systems Biology and Network Analysis**	**8 Hours**
Pathway analysis, gene regulatory networks, metabolic modelling.		
Module 6:	**Ethical and Regulatory Aspects**	**8 Hours**
Data privacy, intellectual property, bioinformatics policies.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd** Yr., 3rd Sem.
Course Title: Recombinant DNA Technology and Protein Engineering-II	**Subject Code:** TIU-PBT-P253D
Contact Hours/Week: **L-T-P 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

Enable the student to:

1. Understand advanced molecular cloning, gene expression, and genome engineering techniques.
2. Explore novel strategies for protein engineering, design, and functional optimization.
3. Analyze high-throughput techniques for recombinant protein production and characterization.
4. Evaluate translational applications of recombinant DNA technology in therapeutics, diagnostics, and synthetic biology..

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain advanced cloning strategies and genome editing technologies.	K2
CO-2	Describe protein engineering approaches and functional optimization.	K3
CO-3	Analyze recombinant protein expression, purification, and characterization methods.	K4
CO-4	Evaluate synthetic biology applications in protein design and metabolic engineering.	K4
CO-5	Interpret industrial and therapeutic applications of recombinant DNA and protein engineering.	K5
CO-6	Apply regulatory guidelines and bioethical considerations in genetic engineering.	K5

COURSE CONTENTS

MODULE 1:	**Advanced Cloning and Gene Manipulation**	**7 Hours**
CRISPR-Cas9 and its applications, Gibson assembly and seamless cloning, Site-directed mutagenesis techniques, Advanced vector design strategies, Homologous recombination and synthetic genes, Genome-wide screening technologies.		
MODULE 2:	**Recombinant Protein Expression Systems**	**8 Hours**
Prokaryotic expression systems (E. coli), Yeast and fungal expression platforms, Mammalian cell-based expression systems, Codon optimization and gene synthesis, Inducible expression and regulatory elements. Challenges in high-yield protein expression.		
MODULE 3:	**Protein Purification and Characterization**	**9 Hours**
Affinity chromatography techniques, Ion exchange and size exclusion chromatography, Protein refolding and stabilization, Mass spectrometry for protein analysis, Structural characterization using X-ray/NMR, Case studies on recombinant protein purification, High-throughput protein analysis techniques**..**		
MODULE 4	**Protein Engineering and Design**	**6 Hours**
Directed evolution and mutagenesis, Computational modeling and AI in protein engineering, Functional assays for engineered proteins, Rational protein design strategies, Case studies on engineered proteins in therapeutics.		
MODULE 5:	**Industrial and Therapeutic Applications**	**6 Hours**
Recombinant enzymes in industry, Biopharmaceuticals: monoclonal antibodies, insulin, hormones, Recombinant vaccines and therapeutic proteins, Metabolic pathway engineering in synthetic biology, Future trends in recombinant protein therapeutics.		
MODULE 6	**Regulatory and Ethical Aspect**	**9 Hours**
FDA and EMA guidelines for recombinant products, Biosafety and containment of GMOs, Ethical concerns in gene and protein engineering, Regulatory approvals and intellectual property rights, Public perception of genetic engineering, Case studies on bioethical dilemmas in biotech, Future policies for genetic engineering, Responsible innovation in genetic engineering.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd**Yr., 3rd Sem.
Course Title: Molecular Immunology II	**Subject Code:** TIU-PBT-P253C
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

- Understand advanced immunological concepts including immunometabolism, neuroimmunology, and transplant immunology.
- Explore the interaction between the immune system and systemic functions such as the nervous system and metabolism.
- Analyze immune challenges in transplantation, aging, and chronic diseases.
- Evaluate the role of cutting-edge immunological techniques in diagnostics and therapy.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the impact of metabolism on immune function and regulation.	K2
CO-2	Describe the communication between the immune and nervous systems.	K3
CO-3	Analyze immune responses in mucosal immunity and microbiota interactions.	K4
CO-4	Evaluate immunological challenges in organ transplantation and rejection.	K4
CO-5	Interpret the molecular basis of immunosenescence and chronic immune-related diseases.	K5
CO-6	Apply emerging immunotechnologies for disease diagnosis and therapy.	K5

COURSE CONTENTS

MODULE 1:	**Immunometabolism and Systemic Immunity**	**7 Hours**
Immunometabolism, energy demands, metabolic pathways, immune regulation, metabolic disorders.		
MODULE 2:	**Neuroimmunology and Stress-Immune Interactions**	**8 Hours**
Brain-immune interactions, cytokines, stress and immunity, autoimmune neuro diseases, microglia.		
MODULE 3:	**Mucosal and Barrier Immunity**	**8 Hours**
Mucosal immune system, microbiota, vaccines, barrier immunity in inflammation.		
MODULE 4:	**Transplant Immunology and Immune Tolerance**	**7 Hours**
Transplant immunology, graft rejection, immune tolerance, immunosuppressive therapies.		
MODULE 5:	**Immunosenescence and Chronic Inflammation**	**8 Hours**
Aging immune decline, inflammaging, age-related diseases, longevity research.		
MODULE 6:	**Emerging Immunotechnologies and Future Trends**	**7 Hours**
Single-cell immunology, AI in immunology, organoids, vaccine advances, personalized medicine.		
Total Lectures		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester: 2nd** Yr., 3rd Sem.
Course Title: Nanotechnology and Nanotherapeutics-II	**Subject Code:** TIU-PBT-P253
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand advanced nanotechnology applications in drug delivery, diagnostics, and theranostics.
2. Explore nanomaterials for biomedical applications, including nanoparticles, quantum dots, and nanocarriers.
3. Analyze toxicity, biocompatibility, and regulatory aspects of nanotherapeutics.
4. Evaluate cutting-edge nanotechnology-based treatment strategies for diseases.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the properties and synthesis of advanced nanomaterials for biomedical use.	K2
CO-2	Describe nanocarriers and targeted drug delivery mechanisms.	K3
CO-3	Analyze nanotoxicity, biocompatibility, and safety concerns in nanomedicine.	K4
CO-4	Evaluate nanotechnology applications in imaging, biosensing, and theranostics.	K4
CO-5	Interpret the clinical translation, regulatory challenges, and commercialization of nanotherapeutics.	K5
CO-6	Apply recent advancements in nanotechnology for disease diagnosis and treatment.	K5

COURSE CONTENT

MODULE 1:	**Advanced Nanomaterials for Medicine**	**7 Hours**
Nanoparticles, carbon nanostructures, quantum dots, nanocomposites, bioconjugation.		
MODULE 2:	**Nanocarriers and Drug Delivery Systems**	**8 Hours**
Liposomes, dendrimers, polymeric nanocarriers, targeted drug delivery, stimuli-responsive systems.		
MODULE 3:	**Nanotoxicology and Biocompatibility**	**8 Hours**
Cellular interactions, toxicity mechanisms, risk assessment, in vitro and in vivo studies.		
MODULE 4:	**Nanotechnology in Imaging and Theranostics**	**7 Hours**
Nano-bio interactions, biosensors, nanoparticle-based imaging, hybrid nanomaterials.		
Module 5:	**Regulatory and Clinical Translation of Nanotherapeutics**	**8 Hours**
FDA guidelines, GMP standards, clinical trials, commercialization strategies.		
Module 6:	**Emerging Trends in Nanomedicine**	**8 Hours**
AI in nanotechnology, 3D nanoprinting, personalized nanomedicine, nano-based immunotherapies.		
TOTAL LECTURES		**45 Hours**

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Department of Biotechnology

Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Research Methodology and Scientific Communication Skills	**Subject Code:TIU-PBT-S253**
Contact Hours/Week: **L-T-P: 2-0-0**	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. Develop a **comprehensive understanding of research methodology in biotechnology**.
2. Gain **skills in data collection, scientific writing, and effective research communication**.
3. Understand **research ethics, intellectual property rights, and funding opportunities**.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Identify different types of research and their significance in biotechnology.	K2
CO-2	Apply appropriate research designs and data collection techniques.	K3
CO-3	Utilize statistical tools for data analysis and interpretation.	K3
CO-4	Develop scientific writing skills for research articles, theses, and grant proposals.	K4
CO-5	Deliver effective oral and poster presentations for scientific communication.	K3
CO-6	Demonstrate awareness of research ethics, plagiarism, and intellectual property rights.	K4

COURSE CONTENTS :

MODULE 1:	**Introduction to Research Methodology**	**5 Hours**

Definition and Objectives of Research

- Types of research (basic, applied, qualitative, quantitative)
- Purpose and significance of research in biotechnology
- Research Process and Problem Identification
  - Defining research problem, reviewing literature
  - Hypothesis formulation and objectives setting
- Research Design and Methods
  - Types of research designs (experimental, descriptive, case studies)
  - Choosing appropriate methodology in biotech research

MODULE 2:	**Data Collection and Analysis**	**5 Hours**

Module 2Data Collection Techniques

- Sampling methods, surveys, experiments, observational studies
- Ethical considerations in data collection
- Data Analysis Techniques
  - Descriptive and inferential statistics
  - Use of software tools (e.g., SPSS, R, MATLAB) for data analysis
  - Interpretation and presentation of data in graphical formats

MODULE 3:	**Scientific Writing and Documentation**	**5 Hours**

- Introduction to Scientific Writing
  - Structure of a scientific paper: Title, abstract, introduction, methods, results, discussion, conclusion, and references
  - Writing proposals, research articles, and review papers
- Citation and Referencing
  - Understanding plagiarism, ethical writing practices
  - Citation styles (e.g., APA, MLA, IEEE) and reference management tools (e.g., EndNote, Mendeley, Zotero)
- Report Writing and Thesis Preparation

- Thesis structure, formatting, and presentation
- Preparing tables, figures, and appendix

MODULE 4:	Scientific Communication Skills	5 Hours

- Oral Presentation Skills
  - Planning and delivering effective scientific presentations
  - Use of visual aids and slide design for academic presentations
- Poster Presentation
  - Designing and presenting scientific posters
  - Engaging with the audience and answering questions
- Effective Communication for Different Audiences
  - Communicating research to non-experts
  - Preparing and delivering elevator pitches for research

MODULE 5:	Research Ethics and Intellectual Property	10 Hours

- Ethics in Research
  - Understanding plagiarism, data integrity, and research misconduct
  - Ethical guidelines in biotechnology and biomedical research
- Intellectual Property Rights (IPR)
  - Patents, copyrights, trademarks, and trade secrets
  - Importance of IPR in biotechnology, filing patents, and copyright basics
- Systematic Reviews and Meta-Analysis
  - Literature search, data synthesis, and interpretation
- Grant Writing and Funding Opportunities
  - Basics of grant writing, structuring grant proposals
  - Sources of funding for research in biotechnology
- Emerging Techniques and Trends in Scientific Communication
  - Use of digital and social media for research dissemination
  - Open-access publishing, preprints, and open science initiatives.

TOTAL LECTURES	30 Hours

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Training	**Subject Code:**TIU-PBT-P263
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. To provide hands-on exposure to industrial/research laboratory practices in biotechnology.
2. To develop technical and analytical skills through real-world training environments.
3. To familiarize students with standard operating procedures, safety, and documentation followed in biotech industries.

   To enhance communication, teamwork, and professional ethics among students during the training experience.

Course Outcome:

CO Number	**Course Outcomes**	**Knowledge levels**
CO1	Identify and describe the roles, responsibilities, and functions of professionals in a biotechnology setup.	K1
CO2	Demonstrate proficiency in handling instruments and techniques commonly used in industrial/research laboratories.	K2
CO3	Apply learned skills to solve technical problems and perform experimental procedures effectively.	K3
CO4	Analyze and interpret data collected during training to draw meaningful conclusions.	K4
CO5	Communicate technical findings through written reports and oral presentations.	K3
CO6	Exhibit professionalism, ethical behavior, and collaboration during industry/research training.	K2

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Project Progress Presentation	**Subject Code:**TIU-PBT-P265
Contact Hours/Week: **L-T-P: 0-0-24**	**Credit: 12**

Course Objective:

1. To guide students in effectively communicating their research progress.
2. To enhance students' skills in data interpretation, analysis, and presentation.
3. To provide a platform for receiving feedback from faculty and peers.
4. To develop scientific reasoning and defense skills.

Course Outcomes:

Course Outcome Code	Course Outcome Statement	Knowledge Level
CO1	Summarize research objectives, methodology, and progress made.	K2
CO2	Interpret experimental data and derive meaningful conclusions.	K3
CO3	Demonstrate effective scientific presentation and communication skills.	K3
CO4	Apply critical thinking to improve the quality and clarity of research output.	K4
CO5	Analyze and incorporate feedback from supervisors and peer discussions.	K4
CO6	Defend research findings and justify scientific approaches used.	K4

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Grand Viva-III	**Subject Code:**TIU-PBT-G251
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. To assess the overall understanding and integration of theoretical and practical knowledge acquired throughout the MTech Biotechnology program.
2. To evaluate the student's ability to articulate complex scientific concepts with clarity and precision.
3. To enhance critical thinking and problem-solving skills through oral examination.
4. To prepare students for professional scientific discussions and interviews in academic or industry settings.

Course Outcomes:

CO Numbers	Course Outcomes	Knowledge levels
CO1	Demonstrate a comprehensive understanding of core and advanced topics in biotechnology.	K4
CO2	Critically analyze and interpret scientific data and experimental outcomes.	K4
CO3	Effectively communicate scientific concepts, both orally and in written form.	K3
CO4	Integrate interdisciplinary knowledge to propose solutions to biotechnological problems.	K4
CO5	Exhibit readiness for higher education, research, or professional roles in the biotechnology sector.	K3
CO6	Respond confidently and accurately to questions reflecting knowledge breadth and depth.	K4

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Seminar-III	**Subject Code:**TIU-PBT-S251
Contact Hours/Week: L-T-P: 0-0-6	**Credit: 3**

Course objectives:

1. To develop in-depth understanding of current research trends in biotechnology.
2. To enhance literature search, comprehension, and critical analysis skills.
3. To improve scientific communication, presentation, and discussion skills.
4. To foster the ability to synthesize complex information and formulate informed opinions.

Course Outcomes:

CO Number	Course Outcome	Knowledge Level
CO1	Identify and explain key advances in biotechnology literature.	K2
CO2	Analyze scientific literature for relevance, novelty, and impact.	K4
CO3	Demonstrate effective scientific presentation and communication skills.	K3
CO4	Critically evaluate peer presentations and provide constructive feedback.	K4
CO5	Summarize current developments in biotechnology through literature reviews.	K2
CO6	Formulate research questions or hypotheses based on existing studies.	K4

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SEMESTER IV

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Project III: Thesis submission and Presentation	**Subject Code:**TIU-PBT-P252
Contact Hours/Week: **L-T-P: 0-0-36**	**Credit: 18**

Course objectives:

1. To enable students to undertake independent research and apply theoretical knowledge in practical problem-solving.
2. To develop critical thinking, data analysis, and scientific writing skills.
3. To enhance communication skills through report preparation and oral presentation of findings

Course outcome:

CO Numbers	Course Outcomes (COs)	Knowledge Level
CO1	Identify and formulate a clear research problem and define relevant objectives.	K3
CO2	Design and execute experiments or simulations with appropriate methodologies.	K4
CO3	Analyze and interpret experimental data using statistical and computational tools.	K4
CO4	Critically evaluate results and draw scientifically valid conclusions.	K4
CO5	Communicate scientific findings effectively through technical writing and presentations.	K3
CO6	Demonstrate independent thinking, project management, and ethical research practices.	K4

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Teaching Ability Assessment	**Subject Code:**TIU-PBT-P260
Contact Hours/Week: **L-T-P: 2-0-0**	**Credit: 2**

Course objectives:

1. To evaluate the teaching preparedness and presentation skills of the student.
2. To develop the ability to plan and deliver lectures effectively to diverse audiences.
3. To assess the use of appropriate pedagogical tools and interactive teaching methods.
4. To build confidence in explaining complex scientific concepts clearly and concisely.

Course outcomes:

CO Number	Course Outcome	Knowledge Level
CO1	Demonstrate effective teaching and communication skills suitable for academic settings.	K3
CO2	Design and deliver structured lectures with clarity and engagement.	K4
CO3	Integrate modern teaching aids and ICT tools into lesson plans.	K3
CO4	Adapt teaching methods based on feedback and audience understanding.	K4
CO5	Critically analyze teaching sessions to improve pedagogical approach.	K4
CO6	Display confidence and competence in handling queries and classroom interaction.	K3

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Quiz & Grand Viva -IV	**Subject Code:**TIU-PBT-G252
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. To assess the comprehensive knowledge gained by students across various subjects in biotechnology.
2. To develop the ability to integrate interdisciplinary knowledge and apply it to research and problem-solving.
3. To enhance students' confidence and communication skills through rigorous questioning and evaluation.
4. To evaluate students' preparedness for professional, academic, or research careers.

Course Outcomes

CO Numbers	Course Outcomes	Knowledge Level
CO1	Recall fundamental and advanced concepts in biotechnology for quiz and viva evaluation.	K1
CO2	Explain interdisciplinary topics with clarity and scientific accuracy during the viva voce.	K2
CO3	Apply core and advanced biotechnology principles to solve hypothetical and real-life scenarios.	K3
CO4	Analyze research problems, experimental designs, and scientific literature during viva.	K4
CO5	Evaluate data interpretation, troubleshooting, and decision-making under viva conditions.	K5
CO6	Communicate ideas effectively and defend scientific reasoning confidently.	K3

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Program: M. Tech. in Biotechnology	**Year, Semester:** 2nd Yr, 3rd Sem.
Course Title: Seminar-IV	**Subject Code:**TIU-PBT-S252
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

Course Objectives:

1. To enhance students' ability to conduct literature reviews and identify relevant scientific content.
2. To develop skills in scientific presentation and effective communication of complex topics.
3. To encourage critical thinking and peer discussion on current advancements in biotechnology.
4. To build confidence in public speaking and academic discussion.

Course Outcomes:

CO Numbers	Course Outcomes	Knowledge Levels
CO1	Identify and summarize relevant scientific literature in the field of biotechnology.	K2
CO2	Analyze and evaluate current research topics in biotechnology.	K4
CO3	Develop and deliver well-structured scientific presentations.	K3
CO4	Demonstrate proficiency in using visual aids and digital tools for academic presentations.	K3
CO5	Engage in critical discussion and provide constructive feedback to peers.	K4
CO6	Exhibit confidence and clarity in scientific communication and defense.	K3