

Syllabus for B.Tech. in Biotechnology



Department of Biotechnology

**Techno India University, West Bengal EM-4,
EM Block, Sector V, Bidhannagar, Kolkata,
West Bengal 700091**



First Semester

Second Semester

S. No	Course Code	Course Title	Contact Hrs. / Week			Credit
			L	T	P	
THEORY						
1	TIU-BS-UMA-T12103	Numerical and Statistical Methods	3	1	0	4
2	TIU-BS-UPH-T12101	Physics	3	1	0	4
3	TIU-ES-UME-T12101	Engineering Mechanics	3	0	0	3
4	TIU-ES-UCS-T12101	Problem-solving using Data Structures	3	0	0	3
5	TIU-ES-UEE-T12101	Basic Electrical and Electronics Engineering	3	1	0	4
PRACTICAL						
1	TIU-ES-UEE-L12101	Basic Electrical and Electronics Engineering Lab and Simulation	0	0	3	1.5
2	TIU-ES-UCS-L12101	Problem-Solving using Data Structures Lab	0	0	3	1.5
3	TIU-ES-UME-L12191	Engineering Drawing and Graphics	0	0	3	1.5
4	TIU-BS-UPH-L12101	Physics lab	0	0	3	1.5
SESSIONAL						
1	TIU-HSM-UES-S12191	Entrepreneurship Skill Development	0	0	2	1
2	TIU-HSM-UEN-S12191	Career Advancement & Skill Development-II Communication Skill	2	0	0	2
3	New code	Sports and Yoga	2	0	0	0
TOTAL CREDIT						26

Third Semester

S. No	Course Code	Course Title	Contact Hrs. / Week			Credit
			L	T	P	
THEORY						
1	TIU-BS-UBT-T21101	Microbiology	3	0	0	3
2	TIU-BS-UBT-T21102	Biochemistry	3	0	0	3
3	TIU-PC-UBT-T21101	Environmental Biotechnology	3	0	0	3

4	TIU-BS-UBT-T21103	CellBiology	3	0	0	3
5	TIU-BS-UBT-T21104	MolecularBiology	3	0	0	3
PRACTICAL						
1	TIU-BS-UBT-L21101	MicrobiologyLaboratory	0	0	3	1.5
2	TIU-BS-UBT-L21102	BiochemistryLaboratory	0	0	3	1.5
SESSIONAL						
1	TIU-HSM-UES-S21191	EntrepreneurshipSkillDevelopment	0	0	2	1
2	TIU-CASD-UCS-S21187	CareerAdvancementandSkillDevelopment	2	0	0	2
3	TIU-ES-UBT-S21191	Technical Seminar	0	0	2	1
TOTAL CREDIT						22

Fourth Semester

Fifth Semester

1	TIU-UBT-T313	Metabolic Engineering	3	0	0	3
2	TIU-UBT-T305	Industrial Biotechnology	3	0	0	3
3	TIU-UBT-T309	Genetics and Biostatistics	3	0	0	3
4	TIU-UBT-T311	Animal Biotechnology	3	0	0	3
5	TIU-UBT-T307	Bioseparation Technology and Downstream Processing	3	0	0	3
PRACTICAL						
1	TIU-UBT-L315	Enzymology Laboratory	0	0	3	1.5
2	TIU-UBT-L317	Bio separation Technology Laboratory	0	0	3	1.5
SESSIONAL						
1	TIU-UES-S381	Entrepreneurship Skill Development	0	0	2	1
2	TIU-UBT-S301	Career Advancement and Skill Development (Bio-Computing I)	2	0	2	3
3	TIU-UBT-S305	Training/Internship	0	0	4	2
TOTAL CREDIT						24

Sixth Semester

1	TIU-UES-S382	Entrepreneurship Skill Development	0	0	2	1
2	TIU-UBT-S302	Career Advancement & Skill Development (Bio- Computing II)	1	0	2	2
TOTAL CREDIT						21

Seventh semester

Eighth Semester

S. No	Course Code	Course Title	Contact Hrs. / Week			Credit
			L	T	P	
THEORY						
1	TIU-UBT-P492	Project Work-II	0	0	16	8
2	TIU-CASD-UBT-S498	Career Advancement & Skill Development (IoT and Biotechnology)	3	0	0	3
3	TIU-UES-S498	Entrepreneurship Skill Development	2	0	0	2
	TIU-UBT-G402	Comprehensive viva-voce	0	0	2	1
TOTAL CREDIT						22



TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Introduction to engineering mathematics (TIU-BS-UMA-T11102)

Program: B. Tech. in Biotechnology	Year, Semester: 1st Yr., 1st Sem.
Course Title: Introduction to engineering mathematics	Subject Code: TIU-BS-UMA-T11102
Contact Hours/Week: 3-1-0 (L-T-P)	Credit: 4

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental concept of differential calculus and integral calculus and their applications.
2. Identify the consistency and inconsistency of a system of linear equations
3. Be able to solve the ordinary differential equations

COURSE OUTCOME:

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

CO-1:	Evaluate the eigen value and eigen vector of a matrix using usual algebraic operation on matrix.	K4
CO-2:	analyse the consistency of a system of linear equations with the concept of rank of a matrix.	K4
CO-3:	analyze the concepts of limits, continuity, and differentiation of functions of single variable and functions of several variables, including Mean Value Theorems and Euler's theorem, to understand their significance in mathematical problem-solving	K4
CO-4:	evaluatedifferent integration techniques, including definite and improper integrals, to determine their applicability in solving real life mathematical problems.	K4
CO-5:	construct the differential equation for a family of curve and solve it also.	K4
CO-6:	assess the effectiveness of differential and integral calculus methods in solving real-world applications, such as rate of change, optimization, and area calculations.	K4

COURSE CONTENT:

MODULE 1:	CONCEPT OF MATRIX AND ITS APPLICATIONS	10 Hours
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Matrices: Algebra of Matrices, Multiplication of Matrices, Transpose of a Matrix, Symmetric & Skew-symmetric Matrix, Lower and Upper Triangular Matrix, Determinants and its properties (up to third order), Adjoint of a Matrix, Inverse of a Matrix, Rank of a Matrix, Echelon Matrix, Solution of a system of linear equations: Cramer's Rule, Characteristic Polynomial, Eigen Value, Eigen Vectors.

MODULE 2:	DIFFERENTIAL CALCULUS	15 Hours
Differential Calculus: Limit of a function, Continuity of a function, Derivatives, Geometric meaning of derivative, successive differentiation, Leibnitz theorem, Rolle's theorem (statement only), Mean value theorems, Taylor's and Maclaurin's theorem, Taylor's series, Functions of several variables, Limit and Continuity, Partial derivatives, Total differential, Jacobian, Homogeneous functions, Euler's theorem on homogeneous functions of two variables.		
MODULE 3: INTEGRAL CALCULUS		
Integral Calculus: Indefinite integrals, Definite integrals and their properties, Integration by Parts, Definite integral as the limit of sum, Idea of improper integrals, Area under a plane curve.		
MODULE 4:	ORDINARY DIFFERENTIAL EQUATION	10 Hours
Ordinary Differential Equation: Definition, Examples, Order, Degree, Formulation of ODEs, Solution of ODEs, Separable Equations, Homogeneous Equations, Linear Differential Equations, Exact Differential equations, Equations reducible to exact form: Integrating Factors.		
TOTAL LECTURES		45 Hours

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	2	-	-	-	-	1	-	2	2	-	2	-
CO2	3	3	2	2	2	-	-	-	-	1	-	2	2	-	2	-
CO3	3	3	2	2	2	-	-	-	-	1	-	2	2	-	2	-
CO4	3	3	2	2	2	-	-	-	-	1	-	2	2	-	2	-
CO5	3	3	2	2	2	-	-	-	-	1	-	2	2	-	2	-
CO6	3	3	2	3	2	-	-	-	-	1	-	3	2	-	2	-

Chemistry (TIU-BS-UCH-T11101)

Program: B.Tech Biotechnology	Year, Semester: 1st year., 1st Sem
Course Title: Chemistry	Subject Code: TIU-BS-UCH-T11101
Contact Hours/Week: 3-1-0 (L-T-P)	Credit: 4

COURSE OBJECTIVE:

Enable the student to:

1.	Impart the basic concept of thermodynamics, chemical kinetics, ionic Equilibria, electrochemistry, stereochemistry, reaction mechanism and chemical bonding and apply the concept in the relevant engineering field of studies.
2.	Understanding the thermodynamic concept helps in acquiring information regarding the feasibility of any processes.
3.	Acquire the knowledge of batteries and fuel cell by understanding the basic concepts of electrochemistry.
4.	Acquire the knowledge of stereochemistry and reaction mechanism helps in understanding the glimpse of the organic reaction pathways.
5.	Impart the knowledge of various types of bonding, energy distributions in atomic and molecular orbital makes the student easier to understand the technology based on them.

COURSE OUTCOME:

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

CO-1:	Understand the concept of chemistry (thermodynamics, chemical kinetics, ionic equilibria, electrochemistry, chemical bonding and isomerism along with reaction mechanism) and applying the same in their engineering branch of studies with a special emphasis to environment, public health and safety.	K2
CO-2:	Apply the concept of chemistry to undertake the interdisciplinary research involving the relevant engineering field of studies.	K3
CO-3:	Analyze the purity of procured chemical compounds based on the acquired knowledge of chemistry related to its physical and chemical properties, which shall in turn used as a starting material for industrial application.	K4
CO-4:	Analyze the knowledge of electrochemistry for better understanding problems related to the mechanism of energy production using electrochemical systems.	K4
CO-5:	Remember the principles of chemical bonding to assess different types of molecular interactions present in varieties of materials and justifying the choice of materials for industrial applications for an engineering solution.	K1
CO-6:	Understand the basic concept of organic reaction mechanism and interpreting this concept in the practical field of industrial applications.	K2

COURSE CONTENT:

MODULE 1:	THERMODYNAMICS	10 Hours
First law of thermodynamics-system, process, Internal Energy, Enthalpy, Concept of reversible and irreversible process, mathematical form of reversible work and irreversible work, Adiabatic reversible expansion, work done in isothermal and adiabatic process, Specific heat capacity, concept of molar specific heat at constant pressure (C_p), molar heat capacity at constant volume (C_v), Relationship between C_p and C_v , Second law of thermodynamics-Carnot cycle, calculating efficiency of machines, entropy, free energy, Gibbs-Helmholtz equation, concept of spontaneous and non-spontaneous process, Maxwell relation, chemical equilibrium.		
MODULE 2:	CHEMICAL KINETICS	6 Hours
Rate of reactions, factors affecting the rate of reaction, Rate laws, order and molecularity of a reaction, half-life period, mechanism of elementary and overall reaction, reversible, consecutive, and parallel reactions, steady state approximation, variation of rate constant with temperature, Arrhenius equation, collision theory, concept of energy barrier, threshold energy, activation energy		
MODULE 3:		12 Hours
A.	ACID-BASE EQUILIBRIA	5 Hours
Strength of acids and bases based on their dissociation constant, Brönsted-Lowry and Lewis concept of acids and bases, Ionic product of water, pH of solutions and pH indicators, Common ion effect, Salt hydrolysis, Buffer solutions, Henderson's equation, Solubility product and its applications.		
B.	ELECTROCHEMICAL SYSTEM	7 Hours
Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis, Ostwald's dilution law, Electrochemical cells, electrolytic cells, EMF of a cell, Application of EMF measurements, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, fuel cells.		
MODULE 4:	CHEMICAL BONDING	8 Hours

Concept of ionic bonding, ionization enthalpy, lattice energy and electro negativity and periodic trends. Covalent bond, sigma and pi bonds: the examples of formation of ammonia, nitrogen, ethene, ethyne, and carbon dioxide, Resonance, Co-ordinate or dative covalent bond: the examples of formation of oxy-acids of chlorine, Hydrogen bonding. Valence Shell Electron Pair Repulsion Theory, Hybridization and shapes of molecules, d- orbital splitting in crystal field (Oh, Td), Molecular orbital theory: Qualitative treatment of homo-nuclear diatomic molecules of first two periods, Energy level diagrams, bonding, anti bonding molecular orbital's, bond order, paramagnetism of O₂ molecule.

MODULE 5:																
A.	ISOMERISM AND CHIRALITY														3 Hours	
Definition and Classification of isomerism – Structural Isomerism, Stereo Isomerism – Geometric isomerism (Cis and Trans only), Optical isomerism, CIP rules, R,S-Configuration																
B.	REACTION MECHANISM														5 Hours	
Concept of Substitution, addition and elimination reactions, concept of homolytic and heterolytic fission, concept of electrophiles and nucleophiles. Inductive, mesomeric, electrometric effects, and hyper-conjugation, leaving group, reaction media, stereo chemical implications, free radicals and polar mechanisms, Nucleophilic substitution at the saturated carbon atom- S ¹ , S ² , and S ⁱ , mechanism, elimination reaction-E1, E2, and E _i CB mechanisms.																
TOTAL LECTURES															44 Hours**	

CO \ Mapp ing	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PS 02	PS 03	PS 04
CO1	3	2	2	2	2	2	2	2	-	1	1	2	2	2	1	2
CO2	3	3	2	2	2	1	1	1	1	2	2	2	2	3	2	2
CO3	3	3	2	3	2	-	-	-	-	1	1	2	2	2	2	2
CO4	3	3	2	3	2	1	2	1	-	1	1	2	2	2	2	2
CO5	3	2	1	1	2	-	-	-	-	1	-	1	2	1	1	1
CO6	3	2	2	2	2	-	-	-	-	1	-	2	2	2	2	2

Chemistry Laboratory (TIU-BS-UCH-L11101)

Program:B.Tech Biotechnology	Year, Semester: Ist year., Ist Sem
Course Title:Chemistry Laboratory	Subject Code:TIU-BS-UCH-L11101
Contact Hours/Week: 0-0-3 (L-T-P)	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1	Understand the safety procedures and follow the protocol while handling chemicals and reagents
2	Remember the best practices of chemistry lab
3	Understand to prepare standard operating procedure for each experiment performed

4	Understand the basic analytical techniques, such as preparation of solutions of desired strength, standardization of solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples using titration and volumetric method.
5	Analyze the result obtained after performing the experiment
6	Identify the chemicals in terms of hazardous and non-hazardous nature and also in terms of purity

COURSE OUTCOME:

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

CO-1:	Remember the safety protocols and best practices inside a chemistry lab, nature of various types of reagents, handling, and storage.	K1
CO-2:	Understand the basic principle in estimating the pH of solution either by pH meter or conductometric analysis or Potentiometric analysis as well as the basic analytical techniques, such as preparation of solutions of desired strength, standardization of solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples.	K2
CO-3:	Apply the concept of titration in knowing the concentration of unknown acid	K3
CO-4:	Evaluate the functional groups present in organic molecules by simple reactions.	K5
CO-5:	Understand the basics of analyzing various types of organic compounds and their properties	K2
CO-6:	Evaluate the hardness of water by performing the complexometric titration and assess the solubility of different solutes in varied solvents.	K5

COURSE CONTENT:

Experiment	Topic	Contact Hours
Experiment-1:	Acid-base titration involving normality and Molarity as a parameter of standards of solution.	3 Hours
Experiment-2:	Determination of the total hardness of water	3 Hours
Experiment-3:	Determination of the relative viscosity of glycerol solution by Ostwald viscometer.	3 Hours
Experiment-4:	Determination of the relative surface tension of glycerol solution by Stalagmometer	3 hours
Experiment-5:	pH metric and Potentiometric titration	3 hours
Experiment-6:	Qualitative analysis- identification of the following in a given salt: Cations : NH_4^{4+} , Pb^{2+} , Cu^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Zn^{2+} , Ca^{2+} , and Mg^{2+}	6 hours
Experiment-7:	Qualitative analysis- identification of the following in a given salt: Anions: CO_3^{2-} , NO_2^- , SO_3^{2-} , SO_4^{2-} , NO_3^- etc.	6 hours
Experiment-8:	Identification of the following compounds and functional groups based on observations: Aliphatic compounds: formaldehyde; ethanol; acetic acid; acetone; glucose etc.	6 hours
Experiment-9:	Identification of the following compounds and functional groups based on observations: Aromatic compounds: benzoic acid; phenol; aniline; benzaldehyde etc.	6 hours
Experiment-10:	Determination of the rate kinetic constant value of ester hydrolysis	3 hours
Experiment-11:	Separation of mixtures of organic compounds utilizing the concept of boiling point/melting point/solubility	3 hours
Total		45 hours

CO-PO-PSO MAPPING:

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PS 02	PS 03	PS 04
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CO 1	3	2	1	2	2	3	3	3	1	1	--	2	2	--	--	3
CO 2	3	3	2	3	3	2	2	2	1	2	--	2	3	2	3	3
CO 3	3	3	2	3	2	2	2	2	1	2	--	2	2	2	3	3
CO 4	3	3	2	3	2	1	1	2	1	2	--	2	2	2	2	3
CO 5	2	2	2	2	2	1	1	2	1	1	--	2	2	2	2	3
CO 6	3	3	2	3	2	2	2	2	1	1	--	2	2	2	2	3

Introduction to Programming (TIU-ES-UCS-T11101)

Program: B. Tech. in Biotechnology	Year, Semester: 1 st Yr., 1 st Sem.
Course Title: Introduction to Programming	Subject Code: TIU-ES-UCS-T11101
Contact Hours/Week: 3–0–0 (L–T–P)	Credit: Theory–3

COURSE OBJECTIVE :

Enable the student to:

1. develop algorithmic problem-solving skills and implement them in C programs.
2. apply modular programming, recursion, and data structures to create interactive C programs.
3. utilize advanced C concepts like structures, pointers, and linked lists for efficient programming.

COURSE OUTCOME :

The student will be able to:

CO1:	Analyze algorithmic solutions to problems.	K4
CO2:	Construct algorithms using C programming.	K3
CO3:	Apply interactive input/output, arithmetic expressions, repetitions, decision-making, and arrays in programs.	K3
CO4:	Organize modular C programs using functions, including recursion.	K3
CO5:	Categorize programs using structures, unions, pointers, and linked lists.	K4
CO6:	Utilize file input and output operations in programs.	K3

COURSE CONTENT :

MODULE 1:	INTRODUCTION TO C LANGUAGE	4 Hours
Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs.		
MODULE 2:	CONDITIONAL STATEMENTS AND LOOPS	6 Hours
Decision making within a program Conditions, Relational Operators, Logical Connectives, if statement, if-else statement. Loops: while loop, do while, for loop, Nested loops, Infinite loops, switch statement, Structured Programming.		
MODULE 3:	ARRAYS	6 Hours
One dimensional arrays: Array manipulation, Searching, Insertion, and Deletion of an element from an array, finding the largest / smallest element in an array; Two dimensional arrays, Addition/ multiplication		

of two matrices transpose of a square matrix, Null terminated strings as array of characters, Representation sparse matrice.

MODULE 4:	FUNCTIONS	7 Hours
Top-down approach of problem solving; Modular programming and functions; Standard Library of C functions; Prototype of a function Formal parameter list, Return Type, Function call, Block structure; Passing arguments to a Function Call by reference, Call by value, Recursive Functions, Arrays as function arguments.		
MODULE 5:	STRUCTURES AND UNIONS	5 Hours
Structure variables, Initialization, Structure assignment, Nested structure, Structures and Functions, Structures and arrays: Arrays of structures, Structures containing arrays, Unions.		
MODULE 6:	POINTERS	9 Hours
Address operators, Pointers type declaration, Pointer assignment, Pointer initialization, Pointer arithmetic, Functions and pointers, Arrays and Pointers, Pointer arrays.		
MODULE 7:	SELF-REFERENTIAL STRUCTURES AND LINKED LISTS	3 Hours
Creation of a singly connected linked list, traversing a linked list, Insertion into a linked list, Deletion from a linked list.		
MODULE 8:	FILE PROCESSING	5 Hours
Concept of Files, File opening in various modes and closing of a file, Reading from a file, writing onto a file.		
TOTAL LECTURES		
45 Hours		

CO-PO-PSO Mapping Table

C O N o.	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O 1	3	3	2	3	3	--	--	2	1	2	1	2	2	--	3	2
C O 2	3	2	2	2	3	--	--	2	1	2	1	2	2	--	3	2
C O 3	3	2	2	2	3	--	--	2	1	2	--	2	2	--	2	2
C O 4	3	2	2	2	3	--	--	2	2	2	--	2	2	--	2	2
C O 5	3	3	2	3	3	--	--	2	2	2	--	2	2	--	2	3
C	3	2	2	2	3	--	--	1	1	2	--	2	2	--	2	2

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Introduction to Programming Lab (TIU-ES-UCS-L11101)

Program: B.Tech. in Biotechnology	Year, Semester: 1 st Yr, 1 st Sem
Course Title: Introduction to Programming Lab	Subject Code: TIU-ES-UCS-L11101
Contact Hours/Week: 0–0–3	Credit: 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Introduce students to the fundamentals of C programming, including syntax, data types, operators, and control structures, enabling them to write and execute basic programs.
2. Develop students' ability to analyze problems, apply algorithmic thinking, and implement solutions using decision-making constructs, loops, functions, and data structures.
3. Equip students with hands-on experience in using arrays, strings, pointers, structures, and unions, enabling them to develop efficient programs for mathematical computations, data processing, and real-world applications.

COURSE OUTCOME :

CO-1	Demonstrate the ability to write, compile, and execute simple C programs using basic input-output functions, arithmetic operations, and control statements.	K2
CO-2	Apply conditional statements (if-else, ternary operator, switch-case) and looping constructs (for, while, do-while) to solve mathematical and logical problems.	K3
CO-3	Solve mathematical problems such as factorial, permutations & combinations, series summation, and trigonometric computations using C programming.	K3
CO-4	Develop programs using arrays and strings to perform operations such as searching, sorting, frequency analysis, and string transformations.	K4
CO-5	Utilize pointers, structures, and unions in C to perform complex operations such as matrix manipulations, complex number arithmetic, and data organization.	K4
CO-6	Implement user-defined functions and demonstrate the ability to use memory management functions, pointers, and structures for efficient data handling.	K4

COURSE CONTENT :

MODULE 1:	Introduction to C Programming & Basic Operations	6 Hours
Writing and executing a basic C program (Hello World). Understanding Input/Output functions (printf(), scanf()). Variables, Data Types, and Memory Allocation. Arithmetic operations and simple mathematical computations		
MODULE 2:	Control Structures & Decision Making	6 Hours
Conditional statements (if-else, ternary operator, switch-case). Looping constructs (for, while, do-while). Nested control structures.		
MODULE 3:	Functions, Recursion & Pattern Printing	6 Hours
Defining and calling user-defined functions. Function parameters, return types, and recursion. Printing patterns using loops (*, numbers, alternating 0/1). Mathematical computations using recursion (Factorial, nCr).		
MODULE 4:	Arrays & Strings	9 Hours
One-dimensional and two-dimensional arrays. Searching & sorting algorithms. String operations (length, frequency analysis, conversion to uppercase/lowercase).		
MODULE 5:	Pointers, Structures & Memory Management	9 Hours

Pointer concepts and memory addresses. Pointer arithmetic and array manipulation using pointers. Structures and Unions for data organization. Dynamic memory allocation concepts.																
MODULE 6: Advanced Programming & Applications															9 Hours	
Matrix operations (Addition, Multiplication). Trigonometric function computations (sin, cos values at intervals). File handling concepts (basic read/write operations).																
TOTAL LAB HOURS																45 Hours

CO-PO-PSO Mapping Table

C O No .	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O1	3	2	1	2	3	--	--	2	1	2	--	2	2	--	2	2
C O2	3	3	2	2	3	--	--	2	1	2	--	2	2	--	2	2
C O3	3	3	2	3	3	--	--	1	1	2	--	2	2	--	2	2
C O4	3	3	2	3	3	--	--	1	1	2	--	2	2	--	3	3
C O5	3	3	2	3	3	--	--	2	1	2	--	2	2	--	3	3
C O6	3	3	2	3	3	--	--	2	1	2	--	2	2	--	3	3

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Basic Computing Lab (TIU-ES-UCS-L11191)_

Program: B.Tech. in Biotechnology	Year, Semester: 1 st Yr, 1 st Sem.
Course Title: Basic Computing Lab	Subject Code: TIU-ES-UCS-L11191
Contact Hours/Week: 0-0-2	Credit: 1

COURSE OBJECTIVE :

Enable the student to:

1. To introduce students to the UNIX/Linux environment and familiarize them with fundamental system operations, commands, and file management techniques.
2. To develop proficiency in shell scripting and command-line utilities for automating tasks, managing processes, and handling files efficiently.
3. To provide hands-on experience with GitHub operations and debugging techniques while enhancing students' ability to work with text processing tools, redirection, and file compression in a UNIX/Linux environment.

COURSE OUTCOME :

CO-1	Be Familiar with the UNIX/Linux operating system	K2
CO-2	Develop proficiency in using shell commands and writing basic shell scripts.	K3
CO-3	Understand file systems, process management, and user permissions.	K2
CO-4	Understand basic github operations and debugging of programs	K3
CO-5	Apply fundamental text processing tools and commands such as grep, find, and text editors (vi/nano) for efficient file manipulation and searching.	K4
CO-6	Utilize redirection, piping, and file compression techniques to manage data effectively in a UNIX/Linux environment.	K4

COURSE CONTENT :

MODULE 1:	INTRODUCTION TO UNIX/LINUX AND BASIC COMMANDS	9 Hours
Overview of UNIX/Linux operating systems, Logging into UNIX/Linux systems, Basic system commands: ls, cd, pwd, cp, mv, rm, clear, man, who, date, cal, etc. Understanding the file system hierarchy: /, /home, /bin, /usr, /var, etc.		
MODULE 2:	FILE AND PROCESS MANAGEMENT	9 Hours
File and Directory Management: Creating, removing, and organizing files and directories, Commands: mkdir, rmdir, touch, chmod, chown, rm, find, etc. Understanding file permissions And ownership (rwx permissions, chmod command)		
Process Management: Viewing active processes (ps, top, htop), Controlling processes: kill, bg, fg, jobs, nice, and renice, Understanding process states: running, sleeping, zombie		
MODULE 3:	TEXT PROCESSING AND BASIC SHELL SCRIPTING	9 Hours
Text Editors (vi, nano): Creating, editing, saving, and existing files, Working with commands like grep, cat, more, less, sed, and awk Basic Shell Scripting: Writing simple shell scripts (bash), Understanding variables, loops (for, while), and conditional statements (if, elif, else), Creating automation scripts for file operations and system monitoring		
MODULE 4:	REDIRECTION, PIPING, AND FILE COMPRESSION	6 Hours
Redirection and Piping: Input/output redirection (>, >>, <) Piping () for command chaining File Compression and Archiving: Working with gzip, tar, zip, unzip, Creating and extracting archives for data backup		
MODULE 5:	GITHUB BASICS AND DEBUGGING TECHNIQUES	6 Hours
Using GitHub for Version Control: Setting up a GitHub repository, Basic commands: git init, git add, git commit, git push, git pull, git clone, Checking in and checking out files Debugging Techniques: Identifying and resolving errors in shell scripts, Using debugging tools (echo, set -x, gdb for C programs)		
TOTAL LAB HOURS		
39 Hours		

CO-PO-PSO Mapping Table

C O No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O1	3	2	1	1	3	--	--	--	1	2	--	2	2	--	2	2
C O2	3	2	2	2	3	--	--	2	1	2	--	2	2	--	2	2
C O3	3	2	1	2	2	--	--	2	1	2	--	2	2	--	2	2
C O4	3	2	2	2	3	--	--	2	1	3	2	2	2	--	3	2
C O5	3	3	2	3	3	--	--	2	1	2	--	2	2	--	3	3

C	3	3	2	3	3	--	--	2	1	2	--	2	2	--	3	3
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Workshop Practice (TIU-ES-UME-L11192)

Program: B. Tech. Biotechnology	Year, Semester: 1 st Yr., 1 st Semester
Course Title: Workshop Practice	Subject Code: TIU-ES-UME-L11192
Contact Hours/Week: 0–0–3 (L–T–P)	Credit: Lab.–1.5
Prerequisite Course: NA	

Course Objective:

Enable the students to

1. Understand workshop safety and gain knowledge on different materials
2. Develop proficiency in using carpentry and fitting shop
3. Learn about sheet metal and welding techniques
4. Understand the working principles and applications of conventional machines

Course Outcome:

CO1	Demonstrate knowledge of workshop safety and materials used in manufacturing processes.	K1
CO2	Explain the use of carpentry, fitting, and sheet metal tools, and perform basic operations.	K2
CO3	Apply various fitting and machining operations such as measuring, marking, drilling, and tapping.	K3
CO4	Analyze different welding techniques (gas, arc, soldering, brazing) and their applications.	K4
CO5	Evaluate the working principles of conventional machines like lathe, shaper, drilling, grinding, and milling.	K6
CO6	Create joints and structures using woodworking, sheet metal, and welding techniques.	K5

Laboratory Content:

Module-1	Carpentry Shop: hours General safety precautions in workshop and introduction. Types of Indian wood used for engineering purposes; Application of timber as per their classification; Carpentry hand tools and machines; Different types of carpentry joints; Different wooden joint preparation.	6
Module-2	Fitting Shop: hours Introduction to fitter's tools, gauges, measuring instruments etc.; Job preparation involving the following operations: measuring and marking, filing, drilling, and tapping.	6
Module-3	Sheet metal shop: hours Introduction, metals used in sheet metal work, hand tools, Sheet metal joints; Soldering.	3
Module-4	Welding Shop: hours Introduction to gas and arc welding; Soldering and brazing etc.; Welding	3

		equipment and welding materials.															
Module-5		Machine Shop: hours 6 Demonstration and working principles of some conventional machines, like lathe, shaper, drilling, grinding, milling machines; General idea of cutting tools of the machines.															
TOTAL PRACTICALS		24 hours															

CO-PO-PSO Mapping Table

C O No .	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O1	3	2	1	1	2	3	2	2	1	2	--	2	2	--	2	2
C O2	3	2	2	2	2	2	--	2	2	2	1	2	2	--	2	2
C O3	3	3	3	3	3	2	--	2	2	2	1	2	2	--	3	3
C O4	3	3	3	3	3	2	--	2	2	2	--	2	2	--	3	3
C O5	3	3	3	3	3	2	--	2	2	2	1	2	2	--	3	3
C O6	3	3	3	3	3	2	--	2	2	2	1	2	2	--	3	3

1.

CAREER ADVANCEMENT & SKILL DEVELOPMENT-I - COMMUNICATION SKILL (TIU-HSM-UEN-S11191)

Program: BTECH Biotech	Year, Semester:1st Year, 1st Sem
Course Title: CAREER ADVANCEMENT & SKILL DEVELOPMENT-I - COMMUNICATION SKILL	Subject Code:TIU-HSM-UEN-S11191
Contact Hours/Week: 2-0-0 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Develop English proficiency for clear, precise, and confident workplace communication.
2. Enhance practical skills in vocabulary, grammar, pronunciation, speaking, and writing.
3. Apply communication theories to improve professional and interpersonal interactions.

COURSE OUTCOME:

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

CO-1:	Explain fundamental communication principles and their relevance in workplace interactions.	K2
CO-2:	Apply grammar and language skills to construct precise and coherent spoken and written communication.	K3
CO-3:	Demonstrate fluency in spoken English through pronunciation drills, vocabulary building, and interactive conversations.	K4
CO-4:	Construct well-organized sentences, paragraphs, and linked paragraphs to enhance professional writing	K3
CO-5:	Develop and revise written communication by employing strategies for drafting, editing, and proofreading.	K3
CO-6:	Assess and refine communication skills to ensure clarity, precision, and confidence in workplace interactions.	K4

COURSE CONTENT :

MODULE 1:	INTRODUCTION TO COMMUNICATION	7 Hours
Definition of Communication, Importance of Communication in the Workplace, Introduction to Communication Theory, Elements of Effective Communication, Barriers to Communication, Verbal and Non-Verbal Communication, Role of Culture in Communication.		
MODULE 2:	LANGUAGE AND GRAMMAR SKILLS	5 Hours
Fundamentals of English Grammar, Sentence Structure and Syntax, Parts of Speech, Tenses and their Usage, Common Errors in Grammar, Punctuation and Mechanics, Effective Use of Vocabulary, Word Formation and Usage, Formal vs. Informal Language.		
MODULE 3:	SPEAKING SKILLS	8 Hours
Principles of Effective Speaking, Pronunciation Drills, Sounds of English: Vowels and Consonants, Stress and Intonation, Developing Conversational Skills, Speaking with Clarity and Confidence, Public Speaking Basics, Expressing Opinions and Arguments, Active Listening and Response.		
MODULE 4:	WRITING SKILLS	8 Hours
The Writing Process: Planning, Drafting, Revising, Editing, Writing Effective Sentences and Paragraphs, Paragraph Development and Coherence, Formal and Informal Writing Styles, Writing Emails and Workplace Documents, Writing Reports and Memos, Common Writing Errors and How to Avoid Them		
MODULE 5:	PRACTICAL LANGUAGE APPLICATION	5 Hours
Building Vocabulary through Context, Word Choice and Precision, Constructing Grammatically Correct Sentences, Exercises in Sentence Formation, Pronunciation Drills and Accent Neutralization, Role-Plays and Dialogues, Group Discussions and Debates, Writing and Structuring Paragraphs, Linking Paragraphs for Coherent Writing.		
MODULE 6:	PROFESSIONAL COMMUNICATION IN THE WORKPLACE	4 Hours

Workplace Communication Etiquette, Business Correspondence, Writing Professional Emails, Preparing Presentations, Communicating in Meetings, Handling Workplace Conversations, Persuasive and Negotiation Skills, Overcoming Communication Barriers, Strategies for Effective Workplace Communication.

TOTAL LECTURES

30 Hours

CO-PO-PSO Mapping Table

C O N o .	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO 1	2	2	1	1	1	3	--	2	2	3	--	3	--	--	1	1
CO 2	2	2	1	1	2	2	--	2	2	3	--	3	--	--	1	1
CO 3	2	2	1	1	2	2	--	2	2	3	--	3	--	--	1	1
CO 4	2	2	1	1	2	2	--	2	2	3	--	3	--	--	1	1
CO 5	2	2	1	1	2	2	--	2	2	3	--	3	--	--	1	1
CO 6	2	2	1	1	2	3	--	3	3	3	--	3	--	--	1	1

Basic Electrical & Electronics Engineering (**TIU-ES-UEE-T12101**)

Program: B. Tech. in Biotechnology	Year, Semester: 1st Yr., 2 nd Sem.
Course Title: Basic Electrical & Electronics Engineering	Subject Code: TIU-ES-UEE-T12101
Contact Hours/Week: 3-1-0 (L-T-P)	Credit: 4

COURSE OBJECTIVE :

Enable the student to:

1. Analyze and describe the basic electrical quantities, circuit elements, and their voltage-current relationships.
2. Design and analyze diode circuits, transistor biasing, and operational amplifier applications.
3. Understand the operation and characteristics of semiconductor devices like diodes, BJTs, JFETs, and MOSFETs.
4. Analyzing differential working principles of single-phase transformers, including voltage transformation and regulation.

COURSE OUTCOME :

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

CO-1:	Understand Basic Electrical Concepts	K2
CO-2:	Analyze DC Electrical Networks	K4
CO-3:	Analyze AC Circuits and Power Systems	K4
CO-4:	Understand Semiconductor Devices and Applications	K2
CO-5:	Design and Analyze Analog Circuits	K3
CO-6:	Understand Transformer Principles and Applications	K2

COURSE CONTENT:

MODULE 1:	Introduction	4 Hours														
Basic electrical quantities, Voltage, Current, Power. Basic Electrical elements: Resistance, Inductance, Capacitance. Their voltage-current relationship. Voltage and current sources.																
MODULE 2:	DC Network Analysis	5 Hours														
KCL and KVL and their applications in purely resistive circuits. Concept of linear, bilateral networks. Source conversion, Star-Delta conversion.																
MODULE 3:	DC Network Theorems	5 Hours														
Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem.																
MODULE 4:	Sinusoidal Steady State Analysis	5 Hours														
Matrix and Determinant: Revision of matrix and determinant, rank and nullity, solutions of system of linear equations using Determinants and Matrices; Eigenvalues and eigenvectors, Cayley-Hamilton Theorem, transformation of matrices, adjoint of an operator, normal, unitary, hermitian and skew-Hermitian operators, quadratic forms.																
MODULE 5:	3-Ph circuits	5 Hours														
Introduction to 3-Ph quantities. 3-Ph star and delta connection. Phasor diagram for 3-Ph system, Balanced 3-Ph loads, measurement of 3-Ph power.																
MODULE 6:	Semiconductor Devices	5 Hours														
Energy bands in solids. Intrinsic and extrinsic semiconductors. P-N junctions. Semiconductor diodes: Zener and Varactor diodes. Bipolar transistors (operation, characteristics).																
MODULE 7:		4 Hours														
Diode Circuits, BJT biasing & Operation of JFET, MOSFET																
MODULE 8:	OPAMPs	5 Hours														
Properties of an ideal and a practical OPAMP. Block diagram. Concept of Virtual Short, Inverting and Non-inverting amplifiers, Summing and Differencing amplifier, Differentiator and Integrator.																
MODULE 9:	1-Ph Transformers	5 Hours														
Faraday's Law, EMF generation (dynamic and static), B-H curve, Construction and operation of single phase transformer: voltage and current transformation, no-load operation, voltage regulation on resistive load.																
TOTAL LECTURES												43 Hours				
C O No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4

.															
CO 1	3	2	1	1	2	--	1	--	1	1	--	2	2	1	2
CO 2	3	3	2	2	2	--	--	1	1	1	--	2	2	1	2
CO 3	3	3	2	2	3	--	--	1	1	1	--	2	2	1	2
CO 4	3	2	1	1	2	--	--	2	1	1	--	2	2	2	2
CO 5	3	3	2	2	3	--	--	2	1	1	--	2	2	2	2
CO 6	3	2	1	1	2	--	--	1	1	1	--	2	2	2	2

Numerical and Statistical Methods (**TIU-BS-UMA-T12103**)

Program: B. Tech. in Biotechnology	Year, Semester: 1st Year, 2 nd Semester
Course Title: Numerical and Statistical Methods	Subject Code: TIU-BS-UMA-T12103
Contact Hours/Week: 3–1–0 (L–T–P)	Credit: 4

COURSE OBJECTIVE:

1. Equip students with numerical techniques for solving mathematical problems, including interpolation, differentiation, integration, and root-finding methods, while understanding error analysis and propagation.
2. Provide a strong foundation in statistical techniques, including measures of central tendency, dispersion, correlation, and regression, to analyze and interpret real-world data effectively.
3. Enable students to implement numerical and statistical techniques to real world problems.

COURSE OUTCOME:

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

CO-1:	analyze different types of errors, their propagation, and estimation techniques to improve numerical accuracy in computations.	K2
CO-2:	apply numerical methods to approximate polynomials, and to find numerical approximations of integration and differentiation of functions	K4
CO-3:	Examine different numerical techniques to find the root of algebraic and transcendental equations, and to solve simultaneous equations	K4
CO-4:	understand various data classification methods, frequency distributions, and graphical representations to interpret statistical data effectively	K2
CO-5:	evaluatedifferent measures of central tendency, dispersion, skewness, and kurtosis to determine their suitability for summarizing and describing datasets.	K4
CO-6:	apply correlation and regression techniques to measure relationships between variables and make data-driven predictions.	K4

COURSE CONTENT:

MODULE 1: NUMERICAL TECHNIQUES		25 Hours
UNIT 1: Errors and approximations, Error type, Analysis and Estimation, Error propagation.		
UNIT 2: Forward, Backward, Shift Operators, Fundamental Theorem of Difference Calculus, Missing term problems.		
UNIT 3: Interpolation with equal and unequal intervals, Newton's forward and backward interpolation formula, Lagrange's formula		
UNIT 4: Numerical Differentiation, Numerical integration- Trapezoidal rule, Simpson's rule.		
UNIT 5: Numerical Solution of algebraic and transcendental equations: Bisection method, Regula-Falsi method, Newton-Raphson method.		
UNIT 6: Solution of simultaneous algebraic equations by Gauss elimination method, Gauss-Jordan method, Gauss- Seidel method.		
MODULE 2: STATISTICAL TECHNIQUES		20 Hours
UNIT 1: Raw data and its classification, Discrete frequency distribution, Sturge's rule, Continuous frequency distribution, Cumulative frequency distribution, Histogram, Frequency curve, Frequency polygon.		
UNIT 2: Arithmetic mean- definition, Effect of change of origin and scale, Combined mean of a number of groups, Geometric mean, Harmonic mean, Weighted A.M., G.M. and H.M., Mode, Median, Empirical relation between mean, median and mode, Order relation between arithmetic mean, geometric mean, harmonic mean, Quartiles.		
UNIT 3: Range, Semi-interquartile range, Mean deviation, Variance and standard deviation, Effect of change of origin and scale.		
UNIT 4: Raw moments for grouped and ungrouped data, Moments about an arbitrary constant for grouped and ungrouped data. Central moments for grouped and ungrouped data, Effect of change of origin and scale, Sheppard's correction. Relations between central moments and raw moments, skewness, kurtosis.		
UNIT 5: Bivariate data, bivariate frequency distribution, Covariance, effect of change of origin and scale, Karl Pearson's and Spearman's coefficient of correlation for grouped and ungrouped data.		
UNIT 6: Correlation & Linear regression, Method of least squares		
TOTAL LECTURES		45 Hours

COURSE ARTICULATION MATRIX

O-PO-PSO Mapping Table

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PS 02	PS 03	PS 04
CO 1	3	3	2	2	2	--	--	--	1	1	--	2	2	1	2	2
CO 2	3	3	2	3	3	--	--	--	1	1	--	2	2	1	2	2
CO 3	3	3	2	3	3	--	--	--	1	1	--	2	2	1	2	2
CO 4	2	2	1	2	2	--	--	--	1	2	--	2	2	2	2	2
CO 5	3	3	2	2	2	--	--	--	1	2	--	2	2	2	2	2

CO 6	3	3	2	2	2	--	--	--	1	2	--	2	2	2	2	2	2
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Physics (TIU-BS-UPH-T12101)

Program: BTech in BIOTECH	Year, Semester: 1st Yr., 2nd Sem
Course Title: Physics	Subject Code: TIU-BS-UPH-T12101
Contact Hours/Week: 3–1–0 (L–T–P)	Credit: 4

COURSE OBJECTIVE:

Enable the student to:

1. Provide a foundational understanding of basic concepts of physics.
2. Develop problem-solving skills and apply the basic concepts of physics in real-world phenomena.
3. Foster critical thinking and analytical skills in applying theoretical knowledge to practical physics problems.

COURSE OUTCOME :

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

CO-1:	Apply basic concepts of mechanics and acoustics	K3
CO-2:	Interpret the concepts of physical optics and explain the principles of lasers along with their applications.	K2
CO-3:	Categorize dielectric and magnetic properties of materials leading to Electromagnetic laws and to analyze crystal structure	K4
CO-4:	Identify the basic properties of conductors, semiconductors, and insulators based on their band structure, and demonstrate their behavior using fundamental band theory concepts.	K3
CO-5:	Apply the principles of wave-particle duality to analyze physical phenomena followed by basic quantum mechanical calculations	K3
CO-6:	Classify ensembles and differentiate between classical and Quantum statistical mechanics	K4

COURSE CONTENT :

MODULE 1:	CLASSICAL MECHANICS	5 Hours
Vector Calculus- gradient of a scalarfield , divergence & curl of a vector field with their physical significance; Frame of references, Mechanics of a single particle - conservative and non-conservative forces, Conservation theorems of linear momentum & angular momentum, Conservation law of energy, Potential energy function $F = -\nabla V$		
MODULE 2:	ACOUSTICS	4 Hours
Harmonic oscillator, Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Attenuation Coefficients of a vibrating system, Forced oscillations and resonance, Mechanical and electrical analogy of forced vibration.		

MODULE 3: OPTICS													8 Hours			
Interference : Interference of electromagnetic wave, condition for constructive and destructive interferences, position of maximum and minimum on the screen (no deduction), Thin film - conditions for thin film appears bright and dark (No deductions) - Newton's ring																
Diffraction- Different types of diffraction, Fraunhofer diffraction at single slit (Intensity distribution curve) ,Diffraction pattern in a Multi Slits & plane diffraction grating (no deduction of the intensity for N slits is necessary), Resolving power of a grating (definition & formulae)																
Polarization of light: Introduction, polarization by reflection - Brewster's law, Malus Law, double refraction, Nicol Prism and its uses, Detection of plane, elliptical and circularly polarized light																
Lasers: Properties of laser, Spontaneous and Stimulated emission, working principle of laser production, amplification of light by population inversion, Einstein's theory of A and Bcoefficients; He - Ne laser , applications of lasers.																
MODULE 4: ELECTROMAGNETISM	5 Hours															
Concept of displacement current, Maxwell field equations and their physical significances, Maxwell field equations for different medium, Maxwell's wave equation & its solution for free space, Electromagnetic energy flow & pointing vector																
MODULE 5: QUANTUM MECHANICS	6 Hours															
Introduction to quantum physics, Wave nature of particles, de Broglie hypothesis, Uncertainty principle, wave functions, concept of probability & probability density, operators, Expectation values. Applications of Schrödinger equation: Schrodinger equation, elementary concepts of particle in a 1D box, quantum harmonic oscillator and Hydrogen atom problem.																
MODULE 6: SOLID STATE PHYSICS	6 Hours															
Elementary idea of crystal structure -lattice, basis ,unit cell, cubic crystal system, co-ordination number& packing factor, Bragg's law and its importance.																
Magnetisation- Magnetic permeability and susceptibility, Relation among B,H& M. Types of magnetic materials, Comparative study among them. Hysteresis& importance of hysteresis curve																
MODULE 7: STATISTICAL MECHANICS	5 Hours															
Qualitative ideas about phase space, macrostates and microstates, density of states, , MB, FD & BE statistics (no deduction necessary), fermions, bosons , Fermi distribution at zero and non – zero temperature.																
MODULE 8: SEMICONDUTOR PHYSICS	6 Hours															
Concept of Fermi gas & Free electron theory of metals, Effective mass of an electron & its importance: concept of hole, Classification of materials on the basis of band structure, Intrinsic and extrinsic semiconductors, Effect of temperature on an extrinsic semiconductor, Fermi energy level and its position for intrinsic and extrinsic semiconductors.																
TOTAL LECTURES	45 Hours															

CO-PO-PSO MAPPING:

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PS 02	PS 03	PS 04
CO 1	3	2	1	2	2	--	--	--	1	1	--	2	2	1	2	2
CO 2	3	2	1	2	2	--	--	--	1	1	--	2	2	1	2	2
CO 3	3	3	2	2	3	--	--	--	1	1	--	2	2	2	2	2
CO 4	3	3	2	2	3	--	--	--	1	1	--	2	2	2	2	2

CO 5	3	3	2	2	2	--	--	--	1	1	--	2	2	2	2	2
CO 6	3	3	2	2	2	--	--	--	1	1	--	2	2	2	2	2

Engineering mechanics (TIU-ES-UME-T12101)

Program:B. Tech. in Biotechnology	Year, Semester: 1st Yr., 2 ND Sem.
Course Title:Engineering mechanics	Subject Code: TIU-ES-UME-T12101
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. understand the basics of vector mechanics and its applications in engineering mechanics
2. analyze problems in statics
3. analyze problems in dynamics of particles

COURSE OUTCOME :

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

CO-1:	To understand the basics of vector mechanics and its application in engineering mechanics.	K2
CO-2:	To understand different force systems and the methods of finding their resultants and to be well-versed with the conditions of equilibrium in 2D.	K2
CO-3:	To be able to apply the laws of static equilibrium in solving problems and perform analysis of statically determinate trusses.	K4
CO-4:	To be able to compute centroids of plane areas, composite areas and to be able to compute area moments of inertias and radii of gyration of plane figures.	K3
CO-5:	To understand basic principles of kinematics of particles, plane, rectilinear and curvilinear coordinate systems and projectile motion	K3
CO-6:	To understand basic principles of kinetics of particles leading to Newton's laws and to be able to apply the work-energy and the linear impulse-linear momentum theorems in solving typical problems	K3

COURSE CONTENT :

MODULE 1:	INTRODUCTION	4 Hours
Introduction: Fundamentals of Mechanics: Introduction to mechanics; Basic concepts – mass, space, time and force; Particles and rigid bodies; Scalars and vectors; Free, sliding, fixed and unit vectors; Addition, subtraction and multiplication of two vectors; scalar triple product and vector product of 3 vectors.		
MODULE 2:	FORCE SYSTEMS AND EQUILIBRIUM	9 Hours
Force systems: Introduction to different force systems; Composition of forces – triangle, parallelogram and polygon law of forces, and addition of two parallel forces; Resolution of forces; Moment of a force, Varignon's theorem; Couples; Force-couple system; Resultant of a force system Equilibrium: Force Systems & Equilibrium: Free body diagram, equilibrium conditions in 2 dimensions, equilibrium of systems involving friction.		
MODULE 3:	STRUCTURES	5 Hours
Plane Truss: Statically determinate trusses; Force analysis of a truss - method of joints, method of sections		
MODULE 4:	DISTRIBUTED FORCES	7 Hours
Distributed Forces: Line, area and volume distributions of forces; Centre of gravity; Centre of mass;		

Centroids of plane figures; Centroids of composite areas. Moment of Inertia: Area moment of inertia; Perpendicular and Parallel axes theorems pertaining to moment of inertia; Radius of gyration.														
MODULE 5: KINEMATICS OF PARTICLES												8 Hours		
Kinematics of Particles: Differential equations of kinematics – plane, rectilinear and curvilinear motions; Cartesian co-ordinate system; Normal and tangent co-ordinate system, projectile motion.														
MODULE 6: KINETICS OF PARTICLES												12 Hours		
Kinetics of Particles: Newton's second law of motion; Work and energy principle – gravitational potential energy, elastic potential energy, kinetic energy, power, work-energy theorem, principle of impulse and momentum.														
TOTAL LECTURES														45 Hours**

CO-PO-PSO Mapping Table

CO\PO/ PSO	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO-1	3	2	1	1	2	--	--	--	1	1	--	2	2	1	1	1
CO-2	3	2	2	1	2	--	--	--	1	1	--	2	2	1	1	1
CO-3	3	3	2	2	3	--	--	--	1	1	--	2	2	1	1	2
CO-4	3	2	2	2	3	--	--	--	1	1	--	2	2	1	1	2
CO-5	3	2	2	1	2	--	--	--	1	1	--	2	2	1	1	2
CO-6	3	3	2	2	3	--	--	--	1	1	--	2	2	1	1	2

Problem Solving using Data Structures (TIU-ES-UCS-T12101)

Program: B.Tech in Biotechnology	Year, Semester: 1st Yr., 2 nd Sem.
Course Title: Problem Solving using Data Structures	Subject Code: TIU-ES-UCS-T12101
Contact Hours/Week: 3–0–0 (L–T–P)	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Introduce fundamental data structures such as arrays, linked lists, stacks, queues, and trees, and their role in computational problem-solving.
2. Develop logical and analytical thinking by applying data structures to efficiently store, process, and manipulate data in various programming scenarios.
3. Enhance problem-solving abilities by selecting appropriate data structures based on efficiency, scalability, and real-world applicability.

COURSE OUTCOME:

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

CO-1	Recall and describe fundamental data structures, including arrays, linked lists, stacks, queues, and trees.	K1
CO-2	Explain searching and sorting techniques, along with their efficiency on different data structures.	K2
CO-3	Apply array and linked list operations to solve computational problems.	K3
CO-4	Implement stack and queue-based algorithms for expression evaluation and problem-solving scenarios.	K3

CO-5	Examine tree-based data structures (Binary Trees, BSTs) and their traversal techniques for problem-solving.	K4
CO-6	Compare different data structures based on their efficiency, scalability, and real-world applicability.	K4

COURSE CONTENT:

MODULE 1:	BASIC CONCEPTS OF DATA REPRESENTATION	6 Hours
Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	ARRAYS	9 Hours
Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays in Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using Arrays: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.		
MODULE 3	SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES	6 Hours
Sequential Search, Binary Search, Comparison-based sorting concepts, Bubble Sort, Insertion Sort, Selection Sort.		
MODULE 4	STACKS AND QUEUES	9 Hours
Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks: Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue: Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.		
Module 5	Linked Lists	6 Hours
Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List: Reverse the order of elements in a singly linked list, Merge two linked lists into one list.		
Module 6	Trees	9 Hours
Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its Applications.		
TOTAL LECTURE		45 Hours

CO-PO-PSO Mapping Table –

CO\PO/ PSO	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO-1	3	2	1	--	2	--	--	--	--	1	--	2	1	--	2	--
CO-2	3	3	2	--	3	--	--	--	--	1	--	2	1	--	3	--
CO-3	3	3	3	2	3	--	--	--	1	1	1	2	2	1	3	--
CO-4	3	3	3	2	3	--	--	--	1	1	1	2	2	1	3	--
CO-5	3	3	3	2	3	--	--	--	1	1	1	2	2	1	3	--
CO-6	3	3	2	3	3	--	--	--	1	1	1	3	2	1	3	1

ENGINEERING DRAWING AND GRAPHICS (TIU-ES-UME-L12191)

Program: B. Tech. in Biotechnology	Year, Semester: 1st Yr., 2nd Sem.
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Course Title:ENGINEERING DRAWING AND GRAPHICS	Subject Code: TIU-ES-UME-L12191
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Develop an understanding of the fundamental concepts and significance of engineering drawing in various engineering disciplines.
2. Acquire skills to construct and analyze engineering curves, projections of points, lines, planes, and solids.
3. Learn to interpret and create orthographic and isometric projections using conventional and computer-aided drafting techniques.
4. Gain proficiency in using drafting software for preparing accurate engineering drawings.

COURSE OUTCOME :

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

CO-1:	Understand the fundamental principles and scope of engineering drawing across various engineering disciplines.	K2
CO-2:	Demonstrate proficiency in constructing and analyzing different engineering curves.	K3
CO-3:	Apply projection techniques for points, lines, planes, and solids in different orientations.	K3
CO-4:	Develop skills to create orthographic and isometric projections accurately.	K3
CO-5:	Interpret and convert between pictorial, orthographic, and isometric views of objects.	K2,K3,K6
CO-6:	Utilize computer-aided drafting tools to create precise engineering drawings.	

COURSE CONTENT :

MODULE 1: Introduction	6 Hours
Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Types of Arrowheads, Lines, Dimension System, Representative Fraction, Types of Scales (plain and Diagonal Scale).	
MODULE 2: Engineering Curves	6 Hours
Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves (Conics-ellipse; parabola; hyperbola with Tangent and Normal).	
MODULE 3: Projection of Points and Straight Lines	9 Hours
Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.	
MODULE 4: Projections of Planes and Solids	9 Hours
Projections of various planes (Polyagonal, Circular, Elliptical shape inclined to one of the reference planes and two of the reference planes) and Projections of Solids (cube, prism, pyramid, cylinder, cone and sphere).	
MODULE 5: Orthographic Projections & Isometric View/Projections	8 Hours
Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection system; Full Sectional Orthographic Views, Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.	
MODULE 6: Overview of Computer Aided Drafting Tools	1 Hours

Introduction to Computer Aided Drafting Software; Basic Tools; Preparation of Orthographic Projections and Isometric Views Using Drafting Software.

TOTAL **39 Hours****

CO-PO-PSO Mapping Table

CO\PO/ PSO	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO-1	3	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1
CO-2	3	3	3	2	3	2	1	1	2	2	1	1	1	1	1	1
CO-3	3	3	3	3	3	2	1	1	2	2	1	1	1	1	1	1
CO-4	3	3	3	3	3	2	1	1	2	2	1	1	1	1	1	1
CO-5	3	3	3	3	3	2	1	1	2	2	1	1	1	1	1	1
CO-6	3	3	3	3	3	3	1	1	2	2	1	1	1	1	1	1

**CAREER ADVANCEMENT & SKILL DEVELOPMENT-II -
COMMUNICATION SKILL (TIU-HSM-UEN-S12191)**

Program: BTech Biotechnology	Year, Semester:1st Year, 2nd Sem
Course Title: CAREER ADVANCEMENT & SKILL DEVELOPMENT-II - COMMUNICATION SKILL	Subject Code: TIU-HSM-UEN-S12191
Contact Hours/Week: 2-0-0 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Develop fluency in spoken and written English for clear, precise, and confident communication.
2. Train in formal writing, reports, proposals, and multimedia presentations.
3. Strengthen people skills, time management, and analytical reading for workplace success.

COURSE OUTCOME :

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

CO-1:	Explain fundamental communication principles and assess their relevance in workplace interactions.	K2
CO-2:	Apply grammar and language skills to construct precise and coherent spoken and written communication	K3
CO-3:	Demonstrate fluency in spoken English through practicing pronunciation drills, developing vocabulary, and engaging in interactive conversations.	K4
CO-4:	Construct well-organized sentences and paragraphs to enhance professional writing.	K3
CO-5:	Develop and revise written communication by employing strategies for drafting, editing, and proofreading	K3
CO-6:	Assess and refine communication skills to ensure clarity, precision, and confidence in workplace interactions.	K4

COURSE CONTENT :

MODULE 1:	COMMUNICATION THEORY AND	7 Hours
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	WORKPLACE DYNAMICS	
Definition of Communication, Communication Models, Workplace Communication Strategies, Effective Messaging, Organizational Communication, Cultural Communication, Verbal and Non-Verbal Cues, Barriers to Communication, Interpersonal and Group Communication		
MODULE 2:	ADVANCED LANGUAGE AND GRAMMAR PROFICIENCY	5 Hours
Morphology and Syntax, Sentence Structuring, Advanced Grammar Rules, Tense Modulation, Phrasal Verbs, Modifiers, Cohesion and Coherence, Lexical Resource, Semantics, Formal vs. Informal Register		
MODULE 3:	STRATEGIC SPEAKING AND ORAL PROFICIENCY	8 Hours
Phonetics and Phonology, Pronunciation Refinement, Stress and Intonation, Articulation and Clarity, Persuasive Speaking, Argumentation and Debate, Spontaneous Speaking, Interview Techniques, Business Pitches, Active Listening Strategies		
MODULE 4:	PROFESSIONAL AND TECHNICAL WRITING	8 Hours
Writing Process Methodologies, Text Structuring, Precision in Writing, Report Writing, Business Proposals, Formal Correspondence, Executive Summaries, Editing and Proofreading, Technical Documentation, Press Releases, Persuasive and Analytical Writing		
MODULE 5:	APPLIED LANGUAGE AND COMMUNICATION EXERCISES	5 Hours
Lexical Expansion, Idiomatic Expressions, Context-Based Learning, Grammar in Context, Role-Plays and Simulations, Speech Analysis, Storytelling Techniques, Collaborative Writing, Dialogues, Workplace Case Studies		
MODULE 6:	CORPORATE COMMUNICATION AND LEADERSHIP SKILLS	4 Hours
Professional Etiquette, Negotiation Tactics, Conflict Resolution, Crisis Communication, Leadership and Persuasion, Presentation Design, Cross-Cultural Communication, Media and Public Relations, Digital Communication Ethics, High-Stakes Conversations		
TOTAL LECTURES		30 Hours

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Program: B. Tech. in Biotechnology	Year, Semester: 1st Yr., 2nd Sem.
Course Title: BASIC ELECTRICAL & ELECTRONICS ENGINEERING	Subject Code: TIU-ES-UEE-L12101
Contact Hours/Week: 0–0–3 (L–T–P)	Credit: 1.5

Course Objective:

1. Fundamental Understanding: To familiarize students with basic electrical concepts such as Ohm's Law, Kirchhoff's Laws, and electrical circuit analysis and basic electronics components such as wires, resistors, bread board, vero board, inductor, capacitor, transformer and different semiconductor devices.
2. Practical Application: To develop skills in handling electrical and electronics instruments, measuring electrical quantities, and analyzing simple circuits.
3. Circuit Design & Analysis: To study and verify the behavior of resistive, inductive, and capacitive circuits.
4. Safety & Precautionary Measures: To understand safety procedures while handling electrical components and high-voltage equipment.
5. Circuit Design & Analysis: To study and verify the behavior of different electrical circuits and semiconductor diodes.
6. Hands-on Exposure: To enable students to practically implement and verify theoretical electrical engineering concepts learned in class.

Course Outcome :

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

CO-1	Identify and recall the fundamental laws and principles of electrical and electronic circuits, including Ohm's Law, Kirchhoff's Laws, and circuit theorems.	K1
CO-2	To implement various electronic circuits using discrete components and to understand their applications.	K1,K2
CO-3	Conduct experiments on electrical networks, resonance, and transient response of RLC circuits	K3
CO-4	Measure and analyze electrical parameters using different instruments (multimeter, oscilloscope, wattmeter, etc.).	K3
CO-5	To study basics of semiconductor & devices and their applications in different areas.	K1,K2
CO-6	Acquire knowledge about diode theory and its application.	K1,K2

Course Content:

Experiment 1	Verification of superposition theorem	3 Hours
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Learn the theoretical foundation of the superposition theorem and its application to linear electrical circuits. Develop skills to systematically analyze circuits containing multiple voltage and current sources by considering one source at a time - Understand how superposition theorem is applied in practical scenarios such as circuit design, troubleshooting, and network analysis.

Experiment 2	Study of R-L-C SERIES Circuit	3 Hours
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Learn the characteristics of resistance, inductance, and capacitance in an AC circuit. Study the concept of impedance (Z) and phase angle in an R-L-C circuit. Examine the phase relationships between voltage and current in a series R-L-C circuit. Understand the concept of leading and lagging power factor. Understand how R-L-C circuit is applied in practical scenarios such as circuit design, troubleshooting, and circuit analysis.

Experiment 3	Verification of Thevenin's theorem	3 Hours
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Learn the theoretical foundation of Thevenin's Theorem, which states that any linear two-terminal circuit can be replaced with an equivalent circuit consisting of a single voltage source (Thevenin voltage) and a series resistance (Thevenin resistance).

Develop problem-solving skills by reducing complicated circuits into simpler equivalent circuits for easier analysis.

Measure and calculate Thevenin's equivalent voltage (V_{th}) and resistance (R_{th}) from a given circuit.

Understand how Thevenin's Theorem is applied in **practical scenarios such as circuit design, troubleshooting, and network analysis.**

Experiment 4	Characteristic of Fluorescent Lamp	3 Hours
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Learn how gas discharge and phosphor coating contribute to light production.

Study the role of the starter, choke (ballast), and electrodes in lamp operation.

Measure voltage, current, and power consumption of a fluorescent lamp.

Understand the starting and operating voltage requirements.

Compare the efficiency of a fluorescent lamp with incandescent and LED lamps.

Analyze the effect of inductive ballast on power factor and ways to improve it.

Compare the performance of electromagnetic and electronic ballasts in terms of efficiency and flickering.

Understand the benefits of fluorescent lamps, such as energy savings and longer lifespan.

Identify common issues like **flickering, warm-up time, and environmental concerns (mercury content).**

Experiment 5	Familiarization with basic electronics components	3 Hours
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Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs

Experiment 6	Study V-I Characteristics of P-N junction Diode in forward bias	3 Hours
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Depletion layer, barrier potential, forward bias, break down voltage, PIV characteristics of PN junction diode, knee voltage, ideal PN junction diode

Experiment 7	V-I Characteristics of Zener Diode in Reverse Bias	3 Hours
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Depletion layer, barrier potential, reverse bias, break down voltage, PIV characteristics of PN junction diode, knee voltage, ideal Zener diode

Experiment 8	Study of Half wave and Full wave rectifier	3 Hours
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Half wave and full wave rectifiers (centre tap and bridge), regulation ripple factor

TOTAL – 45 Hrs

Suggested CO-PO-PSO Mapping Table

CO No .	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO -1	3	3	1	2	1	1	1	1	1	2	1	1	3	2	2	2
CO -2	3	2	3	2	3	1	1	1	2	2	1	2	3	2	2	2
CO -3	3	3	2	3	3	1	1	1	2	2	2	2	3	2	2	2
CO -4	3	3	2	3	3	1	1	1	2	3	2	2	3	2	2	2
CO -5	3	2	1	2	1	1	1	1	1	2	1	1	3	2	2	2
CO -6	3	2	1	2	1	1	1	1	1	2	1	1	3	2	2	2

Physics lab (TIU-BS-UPH-L12101)

Program: B.Tech In BIOTECH	Year, Semester: 1st Yr, 1st / 2nd Sem
Course Title: Physics Lab	Subject Code: TIU-BS-UPH-L12101
Contact Hours/Week: 0-0-3 (L-T-P)	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Provide hands-on experience with experimental techniques in optics, electricity, and mechanics
2. Develop a strong understanding of the fundamental physical constants and properties of materials
3. Enhance students' problem-solving and analytical skills through real-world applications

COURSE OUTCOME:

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

CO-1:	Develop hands-on skills in setting up experimental apparatus and accurately measuring physical quantities.	K3
CO-2:	Analyze experimental data using appropriate methods, interpret results, and assess the reliability and accuracy of measurements.	K4
CO-3:	Correlate theoretical physics principles with experimental observations to understand real-world applications.	K5
CO-4:	Demonstrate the ability to troubleshoot experimental issues and make informed decisions to optimize accuracy.	K5

CO-5:	Document experiments systematically and effectively present results, including calculations and error analysis.	K6
CO-6:	Work collaboratively in a lab environment, maintaining safety protocols and contributing to group discussions and analysis.	K6

COURSE CONTENT:

EXPERIMENT : 1	NEWTON'S RING	3 Hours
Determination of wavelength of a monochromatic light by Newton's ring		
EXPERIMENT : 2	REFRACTIVE INDEX OF WATER	3 Hours
Determination of refractive index of water using travelling microscope		
EXPERIMENT : 3	HALL COEFFICIENT OF SEMICONDUCTOR	3 Hours
Determination of Hall coefficient of semiconductor		
EXPERIMENT : 4	CAREY-FOSTER BRIDGE FOR UNKNOWN RESISTANCE	3 Hours
Determine of unknown resistance using Carey-Foster bridge		
EXPERIMENT : 5	STEFAN'S BOLTZMAN CONSTANT	3 Hours
Determination of Stefan-Boltzmann constant		
EXPERIMENT : 6	BAND-GAP OF SEMICONDUCTOR	3 Hours
Determination of Band gap of a given semiconductor by four probe method		
EXPERIMENT : 7	YOUNG'S MODULUS BY FLEXURE METHOD	3 Hours
Determination of Young's modulus of elasticity of the material of a bar by the method of flexure		
EXPERIMENT : 8	MODULUS OF RIGIDITY BY DYNAMIC METHOD	3 Hours
Determination of modulus of rigidity of the material of a wire by dynamic method		
EXPERIMENT : 9	COEFFICIENT OF VISCOSITY	3 Hours
Determination of coefficient of viscosity of water by Poiseulle's capillary flow method		
EXPERIMENT : 10	PLANCK'S CONSTANT USING PHOTOELECTRIC EFFECT	3 Hours
Determination of Plank's constant using photocell		
EXPERIMENT : 11	THERMOELECTRIC POWER	3 Hours
Determination of thermoelectric power of a given thermo-couple		
Total Hours (Any seven experiments to be performed) 33 Hours		

CO-PO-PSO MAPPING:

C O No .	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O- 1	3	2	2	2	2	1	1	1	2	2	1	3	2	1	1	3
C O- 2	3	3	2	3	3	2	1	1	2	2	2	3	3	1	1	3
C	3	2	3	3	2	1	1	1	2	3	2	3	2	1	1	3

O-3															
C O-4	3	3	3	3	3	2	1	1	3	3	2	3	3	1	1
C O-5	3	3	2	3	2	1	1	1	2	2	1	3	2	1	1
C O-6	3	3	3	3	3	2	1	1	3	3	2	3	3	1	1

Problem Solving using Data Structures Lab (TIU-ES-UCS-L12101)

Program: B.Tech. Biotechnology	Year, Semester: 1 st year, 2 nd semester
Course Title: Problem Solving using Data Structures Lab	Subject Code: TIU-ES-UCS-L12101
Contact Hours/Week: 0–0–3	Credit: 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Develop a strong foundation in data structures and algorithms with a focus on both linear and non-linear structures.
2. Implement and analyze searching, sorting, and graph algorithms to optimize problem-solving efficiency.
3. Enhance programming skills by applying data structures in real-world applications and evaluating their complexity.
4. Understand and assess the time and space complexity of algorithms for efficient software development.

COURSE OUTCOME :

The student will be able to:

CO-1	Understand fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs along with their applications.	K2
CO-2	Implement various data structures using programming techniques to efficiently store, manipulate, and retrieve data.	K3
CO-3	Analyze and apply different searching and sorting algorithms to optimize problem-solving.	K4
CO-4	Evaluate the time and space complexity of algorithms to improve computational efficiency.	K5
CO-5	Apply data structures and algorithms to solve real-world problems and develop efficient software solutions.	K3
CO-6	Explore advanced data structures and algorithmic techniques for tackling complex computing challenges.	K6

COURSE CONTENT :

MODULE 1:	INTRODUCTION	6 Hours
Basic Concepts of Data Representation: Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	ARRAY REPRESENTATION	6 Hours

Arrays: Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using Arrays such as the followings: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.

MODULE 3:	SEARCHING AND SORTING TECHNIQUES	6 Hours
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Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Comparison based sorting concept, Bubble sort, Insertion Sort, Selection Sort.

MODULE 4:	STACK AND QUEUE	9 Hours
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Stacks and Queues: Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks, Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue such as Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.

MODULE 5:	LINKED LISTS	9 Hours
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Linked Lists: Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List such as Reverse the order of elements in a singly linked list, Merge two linked lists into one list.

MODULE 6:	TREE DATA STRUCTURES AND TRAVERSALS	9 Hours
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Trees: Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its Applications.

TOTAL LAB HOURS	45 Hours
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C O No .	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O- 1	3	3	2	2	3	1	1	1	2	3	1	3	3	1	3	2
C O- 2	3	3	3	3	3	1	1	1	3	3	2	3	3	1	3	3
C O- 3	3	3	3	3	3	1	1	1	3	3	2	3	3	1	3	3
C O- 4	3	3	3	3	3	1	1	1	3	3	2	3	3	1	3	3
C O- 5	3	3	3	3	3	2	1	1	3	3	2	3	3	1	3	3
C O- 6	3	3	3	3	3	2	1	1	3	3	2	3	3	1	3	3

Microbiology (TIU-BS-UBT-T21101)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
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Course Title: Microbiology	Subject Code: TIU-BS-UBT-T21101
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

- Understand microbial diversity** through taxonomy, classification, and modern identification techniques.
- Examine microbial structure, growth, metabolism, and genetics** in prokaryotes and eukaryotes.
- Analyze microbial roles in biogeochemical cycles, environmental microbiology, and diseases.**

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Classify microorganisms based on taxonomy, modern approaches, and structural characteristics.	K3
CO-2	Apply aseptic techniques to culture, isolate, and identify microorganisms using microbiological methods.	K4
CO-3	Explain microbial growth, metabolism, and genetics , including reproduction and antibiotic response.	K3
CO-4	Evaluate antimicrobial agents, disinfection, and sterilization methods in controlling microbial growth.	K4
CO-4	Analyze microbial interactions in biogeochemical cycles (Nitrogen, Sulfur, and Phosphorus) and environmental microbiology.	K4
CO-6	Examine foodborne infections, water pollution and waste water treatment and their impact on public health	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Microbial taxonomy including modern approaches such as DNA homology and numerical taxonomy, staining and microscopy, classification of bacteria, and introduction to virus, viroids, prion proteins, Morphology and cell structure of prokaryotes and eukaryotes (bacteria, fungi, algae and viruses),		
MODULE 2:		15 Hours
Cultivation and Maintenance of microorganisms: culture media, Nutritional categories of microorganisms, methods of isolation and preservation of microbial cultures		
MODULE 3:		15 Hours
Bacterial growth and reproduction, Growth curve, factors affecting bacterial growth, bacterial genetics (transformation, conjugation and transduction), mutation, microbial metabolism		
MODULE 4:		

Control of microbial growth by physical and chemical methods, antibiotics, Soil Microbiology- Nitrogen, carbon, Sulphur and Phosphorus cycle, Water microbiology- waste water treatment, coliforms and nuisance microorganisms, Food microbiology- beneficial and spoilage causing microorganisms, major types of food spoilage, Common microbial diseases.

TOTAL LECTURES		45 Hours
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CO-PO -PSO MAPPING

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	--	--	--	--	--	--	--	--	2	--	--	3	2	--	--
CO-2	3	2	2	--	3	--	--	--	--	2	--	2	3	3	--	2
CO-3	3	--	--	--	--	--	--	--	--	--	--	--	3	2	2	--
CO-4	3	2	--	--	--	2	2	--	--	--	--	--	3	2	--	2
CO-5	3	2	--	2	--	--	2	--	--	2	--	2	3	2	--	2
CO-6	--	2	--	--	--	2	2	2	--	2	--	2	--	3	--	2

Biochemistry (TIU-BS-UBT-T21102)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Biochemistry	Subject Code: TIU-BS-UBT-T21102
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

- Understand fundamental biochemical principles** including pH, buffers, and thermodynamics.
- Explore the structure and function of biomolecules** such as nucleic acids, proteins, carbohydrates, lipids, hormones, and vitamins.
- Analyze metabolic pathways** involved in carbohydrate, lipid, amino acid, and nucleotide metabolism.
- Examine protein folding, structure-function relationships, and enzymatic mechanisms.**
- Assess energy transformations in biochemical reactions**, including Gibbs free energy and oxidative phosphorylation.
- Evaluate the biochemical basis of essential physiological processes** like photosynthesis and metabolic regulation.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	<p>Understand the basic concepts of biochemistry and thermodynamics</p> <p>Students will be able to explain fundamental biochemistry concepts, including pH, buffers, and classical thermodynamic principles such as entropy, enthalpy, and Gibbs free energy.</p>	K3

CO-2	Identify and describe the structure and function of biomolecules Students will describe the composition, structure, and functional roles of key biomolecules such as nucleic acids (A, B, Z forms), amino acids, proteins (Ramachandran plot, folding structures), carbohydrates, lipids, hormones, and vitamins.	K3
CO-3	Analyze protein structure and its relation to function Students will analyze protein folding at the secondary, tertiary, and quaternary levels, utilizing models like the Ramachandran plot and understanding domains, motifs, and folds (with examples like myoglobin, hemoglobin, lysozyme, etc.).	K4
CO-4	Apply knowledge of metabolic pathways for energy production Students will apply their understanding of metabolic processes to explain pathways such as glycolysis, the citric acid cycle, oxidative phosphorylation, and the metabolism of lipids, amino acids, and nucleotides.	K4
CO-4	Understand the biochemical processes of photosynthesis Students will explain the fundamental biochemical mechanisms of photosynthesis and how it integrates with broader metabolic processes.	K4
CO-6	Evaluate energy transformations in biochemical reactions, including Gibbs free energy calculations and thermodynamic principles.	K4

COURSE CONTENT:

MODULE 1:		10 Hours
Introduction to biochemistry: pH, buffer, classical thermodynamics, entropy, enthalpy, Gibbs free energy.		
MODULE 2:		15 Hours
Structure function of biomolecules: Composition, structure and function of biomolecules: nucleic acids (A, B, Z forms), amino acids, proteins (Ramachandran plot, folding secondary, tertiary and quaternary structure; domains; motif and folds (Myoglobin, Hemoglobin, Lysozyme, Ribonuclease A, Carboxypeptidase and Chymotrypsin), carbohydrates, lipids, hormones and vitamins.		
MODULE 3:		20 Hours
Metabolism of biomolecules: Metabolism: carbohydrates (glycolysis, citric acid cycle and oxidative phosphorylation, lipid, amino acid and nucleotide metabolism, photosynthesis.		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	--	--	--	--	--	--	2	--	2	3	--	2	--	--
CO-2	3	2	--	--	--	--	--	--	2	--	2	3	3	2	--	--
CO-3	3	2	2	--	--	--	--	--	2	--	2	3	2	2	--	--
CO-4	3	3	2	2	--	--	2	--	2	--	2	3	2	2	2	2
CO-5	3	2	2	2	--	--	2	--	2	--	2	3	2	--	2	2
CO-6	3	2	--	2	--	--	--	--	2	--	2	3	--	2	--	--

Environmental Biotechnology (TIU-PC-UBT-T21101)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Environmental Biotechnology	Subject Code: TIU-PC-UBT-T21101
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. To provide fundamental knowledge of biodiversity, environmental conservation, and pollution from chemical process industries.
2. To introduce bioremediation techniques and biodegradation processes for environmental cleanup.
3. To explore pollution control methods for air, water, and soil, including modern treatment technologies.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand the principles of biodiversity and environmental conservation Students will be able to explain the concepts of biodiversity, conservation, and environmental pollution, including the role of environmental laws, rules, and standards for air, noise, and effluents.	K3
CO-2	Identify the tools and technologies used in environmental monitoring Students will describe how Geographic Information Systems (GIS) and remote sensing technologies are applied in environmental monitoring and forestry management.	K3
CO-3	Analyze the process of bioremediation and biodegradation Students will analyze the role of microorganisms in bioremediation and biodegradation, identifying key types of bioremediation and notable examples, as well as the biotransformation of xenobiotics, hydrocarbons, and heavy metals.	K4
CO-4	Apply methods for air pollution control Students will apply techniques such as mechanical separation, electrostatic precipitation, and gas scrubbing for controlling particulate and gaseous emissions, along with designing systems like cyclones, ESPs, and fabric filters.	K4
CO-5	Understand wastewater management and soil pollution control Students will describe sources of water pollution and explain methods of wastewater treatment (physical, chemical, and biological), along with soil remediation methods like composting, landfill, gasification, and incineration	K4
CO-6	Evaluate solid waste disposal methods, including composting, landfill, gasification, and incineration, and their environmental impact.	K4

COURSE CONTENT:

MODULE 1:	15 Hours
: Introduction: Biodiversity and Conservation. Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental laws and rules, standards for ambient air, noise, emission and effluents, use of GIS and remote sensing in environmental monitoring, environment and forestry.	
MODULE 2:	15 Hours

Bioremediation: Bioremediation: definition; types; notable examples; bioremediation of xenobiotics present in environment, **biodegradation:** biodegradation of pollutants by microorganisms, biotransformation reaction, bioremediation of hydrocarbons and heavy metals from environment.

MODULE 3:		15 Hours
Air Pollution and its control: Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, design of cyclones, ESP, fabric filters and absorbers.		
Water Pollution and its Control: Sources of water pollution waste water management by physical, chemical and biological methods, pre-treatment, solids removal by settling and sedimentation, filtration centrifugation, coagulation and flocculation; activated sludge and lagoons, trickling filter.		
Soil pollution and its control: Application of different ex situ and in situ methods of remediation, solids waste disposal - composting, landfill, briquetting/gasification and incineration.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	--	--	--	3	3	3	--	2	--	2	--	2	--	3
CO-2	3	2	--	--	3	2	2	--	--	2	--	2	--	--	2	2
CO-3	3	3	--	2	--	2	3	2	--	2	--	2	2	3	--	3
CO-4	3	2	3	2	--	2	3	--	--	2	2	2	--	--	2	3
CO-5	3	2	2	2	--	2	3	2	--	2	--	2	--	2	2	3
CO-6	3	2	--	2	--	2	3	2	--	2	--	2	--	2	2	3

Cell Biology (TIU-BS-UBT-T211103)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Cell Biology	Subject Code: TIU-BS-UBT-T211103
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the structure and function of cellular components and organelles.
2. Explore the processes of cell cycle regulation, division, and chromatin organization.
3. Examine the fundamentals of cancer biology and stem cell characteristics

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Identify and describe the structure and function of cellular organelles such as the nucleus, mitochondria, and cell membrane.	K1
CO-2	Explain the composition and role of the cell wall, membrane, and cytoskeleton in maintaining cell integrity and function.	K2

CO-3	Illustrate the phases of the cell cycle, checkpoints, and mechanisms of cell division, including mitosis and meiosis.	K3
CO-4	Apply knowledge of chromatin structure and chromosome organization to understand gene regulation and inheritance.	K3
CO-5	Analyze the key differences between normal cell division and uncontrolled proliferation in cancer cells.	K4
CO-6	Evaluate the significance of stem cells in tissue regeneration and therapeutic applications.	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Structure of cell: Cell wall and cell membrane, cellular organelles (nucleus, mitochondria, golgi apparatus, ER, lysosomes etc) and their structure and function.		
MODULE 2:		15 Hours
Cell cycle and check points, cell division, chromosomes and chromatin structure.		
MODULE 3:		15 Hours
Brief introduction to cancer and stem cells.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	--	--	--	--	--	--	--	2	--	2	3	--	2	--	
CO-2	3	2	--	--	--	--	--	--	2	--	2	3	--	2	--	
CO-3	3	2	2	2	--	--	--	--	2	--	2	3	2	2	--	
CO-4	3	3	2	2	--	--	--	2	--	2	--	2	3	2	2	--
CO-5	3	3	2	2	--	--	2	3	--	2	--	2	3	3	2	2
CO-6	3	2	2	2	--	--	2	2	--	2	--	3	3	3	2	3

Molecular Biology (TIU-BS-UBT-T21104)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Molecular Biology	Subject Code: TIU-BS-UBT-T21104
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the mechanisms of DNA replication, repair, and recombination.
2. Analyze the processes involved in RNA synthesis, processing, and transport.
3. Explore the principles of protein synthesis, including translation, modification, and regulation.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the fundamental concepts of DNA replication, repair mechanisms, and recombination processes.	K2
CO-2	Describe the steps involved in transcription, RNA processing, and transport.	K2
CO-3	Analyze the roles of transcription factors, activators, repressors, and RNA polymerases in gene expression.	K4
CO-4	Illustrate the mechanisms of translation, including initiation, elongation, and termination, along with genetic code interpretation.	K3
CO-5	Evaluate the role of tRNA, aminoacylation, and translational proofreading in protein synthesis fidelity.	K3
CO-6	Apply knowledge of post-translational modifications and translation inhibitors in regulating protein synthesis.	K3

COURSE CONTENT:

MODULE 1:	15 Hours
DNA replication, repair and recombination: Hershey Chase Experiment, Meselson and Stahl Experiment, Unit of replication, enzymes involved, replication origin, replication fork, fidelity of replication, extrachromosomal replicons.	
MODULE 2:	15 Hours
RNA synthesis and 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.	
MODULE 3:	15 Hours
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, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors.	
TOTAL LECTURES	45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	--	--	--	--	--	--	2	--	2	3	--	2	--	--
CO-2	3	2	--	--	--	--	--	--	2	--	2	3	--	2	--	--
CO-3	3	3	2	2	--	--	--	2	--	2	--	2	3	2	3	--

CO-4	3	2	2	--	--	--	--	--	2	--	2	3	--	2	--	
CO-5	3	2	2	2	--	--	--	--	2	--	2	3	--	2	--	
CO-6	3	2	2	2	--	--	--	2	--	2	--	3	3	--	3	2

Microbiology Laboratory (TIU-BS-UBT-L21101)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Microbiology Laboratory	Subject Code: TIU-BS-UBT-L21101
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Develop proficiency in the preparation of media and bacterial culture techniques.
2. Understand and apply microbial isolation, staining, and enumeration methods.
3. Perform biochemical characterization and antibiotic susceptibility testing of bacteria.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Prepare different types of media and slants for bacterial culture.	K1
CO-2	Demonstrate pure culture isolation using slant and streak plate techniques.	K2
CO-3	Perform dilution plating for viable bacterial count estimation.	K3
CO-4	Identify bacterial morphology through simple staining and Gram staining techniques.	K3
CO-5	Conduct biochemical tests such as catalase, oxidase, and urease for bacterial characterization.	K4
CO-6	Evaluate bacterial susceptibility to antibiotics using the disc diffusion method.	K4

Course content

MODULE 1:	EXPERIMENT : 1	Total hours 90 hours
Preparation of media and slants for bacterial culture, hand on training		
MODULE 2:	EXPERIMENT : 2	
Isolation of pure culture in slant techniques and by streak plate techniques, evaluation		
MODULE 3:	EXPERIMENT : 3	
Dilution plating for viable count, assessment		
MODULE 4:	EXPERIMENT : 4	
Simple staining and gram staining of bacteria, assignment		

MODULE 5:	EXPERIMENT : 5	
	Biochemical Characterization of Bacteria: Catalase, Oxidase and Urease Tests.evaluation and presentation	
MODULE 6:	EXPERIMENT : 6	
	Antibiotic Assay (Disc Diffusion Method), evaluation and assessment	

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	--	--	--	--	--	--	--	2	--	2	3	--	--	--	2
CO-2	3	2	--	--	2	--	--	--	2	--	2	3	2	--	--	3
CO-3	3	2	2	--	--	--	--	--	2	--	2	3	2	--	--	3
CO-4	3	2	2	--	--	--	--	--	2	--	2	3	2	--	--	2
CO-5	3	3	2	2	--	--	--	2	--	2	--	2	3	3	--	3
CO-6	3	3	2	2	--	2	2	2	--	2	--	3	3	3	--	3

Biochemistry Laboratory (TIU-BS-UBT-L21102)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 3rd Sem.
Course Title: Biochemistry Laboratory	Subject Code: TIU-BS-UBT-L21102
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental concepts of solution chemistry and their applications.
2. Develop skills in pH measurement, spectrophotometry, and biochemical estimations.
3. Perform chromatographic techniques for the separation and analysis of biomolecules.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand the concepts of solution concentration and inter-conversion Students will explain the concepts of normality, molarity, molality, and percentage solutions and demonstrate their inter-conversion in different chemical contexts.	K1
CO-2	Apply pH measurement techniques using pH meters and buffers Students will operate pH meters and prepare pH buffers, applying these techniques to accurately measure the pH of various solutions.	K2
CO-3	Determine the isoelectric point of amino acids Students will apply methods to determine the isoelectric point of amino acids, understanding how it affects the solubility and charge of proteins.	K3
CO-4	Understand the principles of spectrophotometry and absorption maxima Students will describe the basic workings of a spectrophotometer,	K3

	explain the concept of absorption maxima, and relate it to the quantification of biomolecules.	
CO-5	Apply spectrophotometric techniques to estimate biomolecules Students will estimate the concentration of nucleic acids, amino acids, proteins, carbohydrates, and fats using spectrophotometric methods.	K4
CO-6	Perform chromatographic techniques for amino acid separation Students will apply paper chromatography and thin-layer chromatography (TLC) techniques to separate and identify different amino acids based on their migration properties.	K4

Course content

EXPERIMENT 1:	Concept of Normality, Molarity, Molality, Percentage solutions and their conversion, problem solving and evaluation	Total hours 90 HOURS
EXPERIMENT 2	Operation of pH meter and pH buffers, evaluation	
EXPERIMENT 3	Isoelectric point determination of amino acids, assessment	
EXPERIMENT 4	Introduction to spectrophotometer, absorption maxima and Beer Lambert's Law, problem solving and evaluation	
EXPERIMENT 5	Estimation of nucleic acids, amino acids, proteins, carbohydrates and fats, assessment	
EXPERIMENT 6	Separation of amino acids by Paper chromatography and TLC, problem solving and evaluation	

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	--	--	--	--	--	--	--	2	--	2	3	--	--	--	2
CO-2	3	2	--	--	3	--	--	--	--	2	--	2	3	--	2	2
CO-3	3	2	2	--	--	--	--	--	--	2	--	2	3	2	2	2
CO-4	3	2	--	--	2	--	--	--	--	2	--	2	3	--	2	2
CO-5	3	3	2	2	2	--	--	2	--	2	--	2	3	2	2	2
CO-6	3	3	2	2	2	--	--	2	--	2	--	3	3	2	2	3

CAREER ADVANCEMENT & SKILL DEVELOPMENT (TIU-CASD-UCS-S21187)

Program: Btech Biotechnology	Year, Semester: 2 nd year, 3 rd sem
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Course Title: Career Advancement and Skill Development (Python programming)	Subject Code: TIU-CASD-UCS-S21187
Contact Hours/Week: 2-0-0 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Acquire basic communication skills in French.
2. Develop listening, speaking, reading, and writing abilities at a beginner level.
3. Understand and use simple grammatical structures and everyday vocabulary.
4. Engage in basic conversations in French related to common situations.

COURSE OUTCOME :

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

CO-1:	Recognise and use common French greetings and expressions.	K1
CO-2:	Memorise and repeat simple sentences using regular verbs and basic vocabulary.	K1
CO-3:	Understand and respond to basic questions about personal identity.	K2
CO-4:	Identify and explain short passages related to daily life.	K2
CO-5:	Construct short texts such as self-introductions and informal messages.	K3
CO-6:	Arrange isolated sentences and questions to engage in simple spoken exchanges in a variety of familiar contexts.	K4

COURSE CONTENT :

MODULE 1:	INTRODUCTION TO FRENCH LANGUAGE <ul style="list-style-type: none"> · The French alphabet and pronunciation · Greetings and introductions · Numbers and basic expressions of time 	6 Hours
MODULE 2:	IDENTITY AND PERSONAL INFORMATION <ul style="list-style-type: none"> · Talking about oneself and others · Nationalities, professions, and family · Using "être" and "avoir" verbs 	6 Hours
MODULE 3:	EVERYDAY INTERACTIONS <ul style="list-style-type: none"> · Asking for and giving personal details · Talking about preferences and habits · Introduction to regular -ER verbs 	7 Hours
MODULE 4:	<ul style="list-style-type: none"> · Ordering at a café or restaurant · Asking for directions · Using "aller" and "faire" verbs 	6 Hours
MODULE 5:	DESCRIBING DAILY LIFE <ul style="list-style-type: none"> · Talking about routines and leisure activities · Expressing likes and dislikes · Introduction to present tense conjugation 	5 Hours
TOTAL LECTURES		30 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	--	--	--	--	2	--	2	--	3	--	2	--	--	--	--
CO-2	2	--	--	--	--	--	--	2	--	3	--	2	--	--	--	--
CO-3	2	2	--	--	--	--	--	--	--	3	--	2	--	--	--	--
CO-4	2	2	--	--	--	--	--	--	--	3	--	2	--	--	--	--
CO-5	2	2	2	--	--	--	--	--	--	2	3	--	2	--	--	--
CO-6	2	3	2	--	--	--	--	--	3	3	2	3	--	--	--	--

Genetic Engineering (TIU-UBT-T202)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Genetic Engineering	Subject Code: TIU-UBT-T202
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental tools and techniques of genetic engineering.
2. Develop skills in molecular cloning, hybridization, and gene expression analysis.
3. Explore applications of genetic engineering in drug development and enzyme stability.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand the mechanisms of action of restriction and modification enzymes Students will explain the types and mechanisms of action of restriction and modification enzymes, as well as the use of different vectors such as plasmids, bacteriophage, cosmids, and YAC/BAC in genetic engineering.	K1
CO-2	Apply knowledge of vectors in gene cloning and expression systems Students will apply their understanding of vectors like viral vectors, Ti plasmid, and mammalian/plant expression vectors to gene cloning and siRNA technology.	K2
CO-3	Understand the principles of polymerase chain reaction (PCR) and its types Students will describe the principles and types of PCR, including random primers, and explain its use in cloning, expression, and the creation of cDNA libraries.	K3
CO-4	Apply techniques for screening and labeling of nucleic acids Students will apply techniques for screening cDNA and genomic	K3

	libraries, synthesizing and labeling DNA/RNA probes, and performing hybridization methods such as Southern, Northern, and Western blotting.	
CO-5	Understand DNA sequencing methods and mutagenesis techniques Students will explain various DNA sequencing methods (Maxam-Gilbert, Sanger, deep sequencing), site-directed mutagenesis, and techniques like RAPD, RFLP, and AFLP for genetic analysis.	K4
CO-6	Apply genetic engineering methods in practical applications Students will apply genetic engineering techniques to areas such as drug development, enzyme stability (e.g., heat stability), and transgene silencing, understanding the practical applications in biotechnology.	K4

COURSE CONTENT:

MODULE 1:	10 Hours
Restriction and modification enzymes (types and mechanism of action), vectors and plasmids (bacteriophage, viral vectors, cosmids, Ti plasmid, YAC, BAC, mammalian and plant expression vectors), siRNA technology.	
MODULE 2:	10 Hours
Polymerase chain reaction and its types, random primers, cloning and expression, cDNA libraries, screening of cDNA and genomic libraries, synthesis and labeling of DNA and RNA probes, nick translation, end labeling, hybridization probe method, antibody screening, southern, western and northern hybridization.	
MODULE 3:	10 Hours
: DNA sequencing-Maximum-Gilbert, Sanger's method and Deep sequencing, Site directed mutagenesis, genetic transformation, transgene silencing, RAPD, RFLP, AFLP.	
MODULE 4:	15 Hours
: Applications of genetic engineering: drug development, stability of enzymes (heat stability)	
TOTAL LECTURES:	45 Hours**

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	--	--	--	--	--	--	--	2	--	2	3	2	--	2
CO-2	3	2	2	--	2	--	--	2	--	2	--	2	3	3	--	3
CO-3	3	2	--	2	2	--	--	--	--	2	--	2	3	2	3	2
CO-4	3	2	2	2	2	--	--	2	--	2	--	2	3	2	2	3
CO-5	3	3	2	3	2	--	--	2	--	2	--	2	3	2	3	2
CO-6	3	3	3	3	2	2	2	2	2	2	2	3	3	3	3	3

Immunotechnology (TIU-UBT-T204)

Program: B. Tech. in BT	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Immunotechnology	Subject Code: TIU-UBT-T204
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the basic principles of immunology, including innate and adaptive immunity.
2. Explore host defense mechanisms against infections and immune evasion strategies by pathogens.
3. Analyze immune-related disorders, transplantation immunology, and hypersensitivity reactions.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the fundamental concepts of innate and adaptive immunity, including humoral and cellular responses.	K2
CO-2	Describe the activation and function of T and B cells, and the role of MHC in antigen processing and presentation.	K2
CO-3	Illustrate the mechanisms of host defense against pathogens and their immune evasion strategies.	K3
CO-4	Analyze immune responses in transplantation, allograft rejection, and the role of MHC molecules.	K4
CO-5	Evaluate autoimmune diseases, their causes, and criteria for diagnosis.	K4
CO-6	Assess different types of hypersensitivity reactions and the concept of immune tolerance.	K4

COURSE CONTENT:

MODULE 1:	15 Hours
Introduction, innate and acquired immunity, active, passive and adoptive immunization, complement system, clonal selection theory, humoral and cellular Immunity, Regulation of Immune response, Cellular responses, primary and secondary lymphoid organs, activation and function of T and B cells, role of Major Histocompatibility Complex (MHC) in antigen processing and presentation.	
MODULE 2:	15 Hours
Infection and immunity, host defence against various classes of pathogen, mechanism by which pathogens evade immune responses, active and passive immunization.	
MODULE 3:	15 Hours
Transplantation, relationship between donor and recipient, role of MHC molecules in Allograft rejection, Autoimmunity, criteria and causes of autoimmune diseases-(Autoimmune hemolytic anemia, myasthenia gravis, systemic lupus erythematosus, multiple sclerosis, rheumatoid	

arthritis), hypersensitivity (Type I, II, III, IV), Immune Tolerance.

TOTAL LECTURES		45 Hours
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CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	0	0	0	0	0	0	0	0	3	3	3	0	0	0
CO-2	3	2	0	0	0	0	0	0	0	0	3	3	3	0	1	
CO-3	2	3	0	0	2	2	2	0	0	0	3	3	3	2	0	
CO-4	2	3	0	2	0	3	2	2	0	0	0	2	3	3	2	1
CO-5	2	3	0	2	0	2	2	2	0	0	0	2	3	3	2	2
CO-6	2	3	0	2	0	3	2	2	0	0	0	2	3	3	2	0

Nanotechnology and Biomaterial Science (TIU-UBT-T216)

Program: B. Tech. in BT	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Nanotechnology and Biomaterial Science	Subject Code: TIU-UBT-T216
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

- 1) Recognize the fundamentals of biomaterials and nanotechnology.
- 2) Acquire knowledge of nanoscale materials, their special qualities, and production processes.
- 3) Examine the uses of nanomedicine in tissue engineering, drug delivery, and diagnostics.
- 4) Recognize how biomaterials contribute to the creation of cutting-edge, sustainable medical solutions.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Recall fundamental concepts of nanoscience, including different types of nanoparticles (0D, 1D, 2D, 3D) and their unique properties	K1
CO-2	Explain various nanoparticle synthesis and characterization techniques, including Top-Down and Bottom-Up approaches, SPM, AFM, and STM.	K2
CO-3	Describe the role of bio-nanotechnology in biological systems, including naturally occurring nanoparticles and molecular motors (e.g., myosin, kinesin, dynein).	K2
CO-4	Analyze the significance of ion channels as molecular switches and their applications in nanotechnology.	K4
CO-5	Apply knowledge of biodegradable nanoparticles (liposomes,	K3

	dendrimers, gold/silver nanoparticles) for targeted drug and gene delivery	
CO-6	Compare different nanomedicine applications, including smart drugs, DNA-based nanodevices, nanorobotics, and nanomedical diagnosis.	K4

COURSE CONTENT:

MODULE 1:		14 Hours
Introduction to nanoscience and nanotechnology; Concept of 3D, 2D, 1D and 0D nano particles and their behaviour, Different important types of nanoparticles: Quantum Dot, Nanowire, Nanotube, Nanocage, Buckminster fullerene etc. Synthesis and characterization of nanoparticles and nano-structured machinery, Top Down and Bottom Up Approach, Scanning probe microscopy (SPM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM). Photoreceptors as single photonopticaldetector; manipulating redox systems application in nanotechnology.		
MODULE 2:		13 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 3:		18 Hours
Introduction to Nanomedicine, Application of Nanomedicine; Biosensors; Biodegradable 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. Improved Human Abilities; Chromosome Replacement Therapy.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	1	2	1	1	1	1	1	1	2	3	2	2	2
CO-2	3	3	2	2	3	1	1	1	1	2	1	2	3	2	2	2
CO-3	3	3	2	2	2	2	1	2	1	2	1	2	3	3	2	2
CO-4	3	3	3	3	3	2	1	2	2	2	2	3	3	3	3	3
CO-5	3	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3
CO-6	3	3	3	3	3	3	2	2	2	3	2	3	3	3	3	3

Bioprocess Engineering (TIU-UBT-T206)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Bioprocess Engineering	Subject Code: TIU-UBT-T206
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

- Understand the fundamentals of fermentation technology and bioprocess optimization.
- Learn about bioreactor design, operation, and scale-up strategies.

3. Apply engineering principles to upstream and downstream processing for industrial bioprocessing.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Describe the basics of bioprocess technology, including fermentation types, microbial growth kinetics, product kinetics and stoichiometry.	K2
CO-2	Explain the design and classification of bioreactors, along with operating parameters and mass/heat transfer aspects.	K3
CO-3	Apply sterilization techniques and microbial death kinetics for ensuring aseptic conditions in bioprocessing.	K4
CO-4	Analyze rheology, gas-liquid mass transfer, and the significance of dimensionless parameters in bioreactor operations	K4
CO-5	Assess the challenges and considerations in scale-up processes from lab to industrial scale.	K4
CO-6	Design and evaluate upstream and downstream processing strategies for microbial, animal, and plant cell cultures.	K6

COURSE CONTENT:

MODULE 1:		15 Hours
Basics of Bioprocess technology, Range of fermentation processes, Introduction to Upstream and downstream technology, Modes of fermentation: batch, fed-batch and continuous, Microbial growth kinetics- Monod kinetics, Product kinetics, Solid state and submerged fermentation, Stoichiometry of cell growth- Respiratory Quotient, Degree of Reduction		
MODULE 2:		15 Hours
Bioreactor design and operation: Bioreactor parts and function, classification of reactors; designing parameters for reactors (stirred tank reactor, airlift reactor, plug flow reactor, bubble flow, photobioreactor, membrane and packed bed bioreactor), rheology of fermentation broth, gas-liquid mass transfer, heat transfer, analysis of dimension less parameters and their application (aeration number, power number and Reynold's number;		
MODULE 3:		15 Hours
Sterilization- steam and filter sterilization, Batch and continuous sterilization, microbial death kinetics		
MODULE 4:		
Scale-up of bioprocesses: parameters used in scale-up and problems associated with scale-up. Microbial, animal and plant cell culture platforms.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
CO-1	3	2	2	2	2		2		1	1			2	3	2	3	2
CO-2	3	3	3	2	3		2	1	1	2	2	2	3	2	3	2	
CO-3	2	2	2	3	3	1	2	2	2	2	1	2	2	2	2	3	
CO-4	3	3	3	3	3		2	2	2	2	2	3	3	2	3	2	
CO-5	2	2	3	3	2	1	3	1	1	2	3	2	2	2	2	2	
CO-6	3	3	3	3	3	2	3	2	2	3	3	3	3	3	3	3	

Genetic Engineering Laboratory (**TIU-UBT-L292**)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Genetic Engineering Laboratory	Subject Code: TIU-UBT-L292
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental molecular biology techniques for DNA isolation, PCR, and cloning.
2. Analyze and interpret the results of gel electrophoresis, restriction digestion, and bacterial transformation.
3. Design and implement cloning strategies, including plasmid isolation and recombinant screening.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the principles and protocols for genomic and plasmid DNA isolation.	K2
CO-2	Demonstrate PCR amplification, restriction digestion, and gel electrophoresis techniques.	K3
CO-3	Perform bacterial transformation and analyze transformed colonies.	K4
CO-4	Evaluate the efficiency of restriction digestion, cloning, and transformation.	K4
CO-5	Utilize molecular biology tools for screening recombinant clones.	K3
CO-6	Design and execute an experiment integrating multiple molecular biology techniques.	K6

Experiment 1:	Isolation of genomic DNA from bacteria, hand in testing	Total hours 90 HOURS
Experiment 2:	Miniprep isolation of plasmid DNA, evaluation	
Experiment 3:	Restriction digestion of plasmid DNA and agarose gel electrophoresis of restriction digests and PCR products,	

		hand on testing and assignment	
Experiment 4:		Cloning of PCR product into the isolated plasmid, assessment	
Experiment 5:		Bacterial Transformation and Identification and characterization of transformed colonies, presentation	
Experiment 6:		PCR amplification of GOI, kab evaluation and presentation	

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	3	1	1	2	1	1	1	1	2	1	1	3	1	2	1
CO-2	3	3	1	1	3	1	1	1	1	2	1	1	3	1	1	2
CO-3	3	2	3	1	3	1	1	1	2	1	1	1	3	1	1	3
CO-4	1	3	3	3	3	1	1	1	1	1	2	1	3	1	1	3
CO-5	3	2	2	1	3	1	1	1	1	1	1	1	3	2	1	2
CO-6	1	1	3	3	3	1	1	1	3	1	3	1	3	1	1	3

Immunotechnology Laboratory (TIU-UBT-L294)

Program: B. Tech. in Biotechnology	Year, Semester: 2nd Yr. 4th Sem.
Course Title: Immunotechnology Laboratory	Subject Code: TIU-UBT-L294
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and applications of immunological techniques.
2. Perform antigen-antibody interaction assays using various immunological methods.
3. Analyze immunological experimental data for research and diagnostic applications.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Recall the basic principles of immunological techniques.	K1
CO-2	Explain the concept of antigen-antibody interactions and their significance in immunological assays.	K2
CO-3	Demonstrate immunological techniques such as blood grouping, ELISA, and immuno-electrophoresis.	K3
CO-4	Perform Western blotting for protein detection and immuno-electrophoresis for antigen characterization.	K3
CO-5	Analyze experimental results from immunological techniques and	K4

	interpret diagnostic findings..	
CO-6	Apply immunological techniques in research and clinical diagnostics for disease detection.	K3

Course Content

Experiment 1:	ABO Blood grouping, hand on testing and evaluation	Total hours 90 HOURS
Experiment 2:	Assessment of antigen similarity using Ouchterlony double diffusion test. Presentation	
Experiment 3:	DOT ELISA test, assessment	
Experiment 4:	Quantitative ELISA, assignment	
Experiment 5:	Immuno-electrophoresis, presentation	
Experiment 6:	Western Blotting, lab evaluation and assessment	

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1	1
CO-2	3	3	1	1	2	1	1	1	1	2	1	1	3	3	1	1
CO-3	3	3	2	2	3	1	1	1	2	2	1	1	3	3	1	2
CO-4	3	3	2	2	3	1	1	1	2	2	1	1	3	3	1	2
CO-5	2	3	2	3	2	1	1	1	2	2	1	1	3	3	1	2
CO-6	3	3	3	3	3	1	1	1	3	3	2	1	3	3	1	3

Career Advancement and Skill Development (R programming) (TIU-CASD-UBT-S288)

Program: B.Tech in Biotech	Year, Semester: 2nd Yr 4th Sem.
Course Title: Career Advancement and Skill Development (R programming)	Subject Code: TIU-CASD-UBT-S288
Contact Hours/Week: 1–0–2 (L–T–P)	Credit: 2

COURSE OBJECTIVE:

This course aims to enable the student to:

1. Understand the basics of R programming and its role in data analysis and visualization.
2. Apply fundamental programming concepts using R for handling and manipulating various data types.
3. Develop skills in data cleaning, transformation, and wrangling using packages like dplyr and tidyr.
4. Visualize complex datasets effectively using ggplot2 and interpret graphical outputs.
5. Perform basic statistical analyses and generate reproducible reports using R Markdown.
6. Enhance analytical thinking and problem-solving skills applicable in scientific research and industry.

7. Prepare for career opportunities requiring data literacy and computational proficiency in R.

Course Outcomes

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand the fundamentals of R programming and its applications in data analysis	K2
CO2	Apply appropriate data structures and functions in R to manipulate data	K3
CO3	Analyze datasets using data wrangling techniques and summarization tools	K4
CO4	Create effective data visualizations using ggplot2	K6
CO5	Perform basic statistical tests and interpret results using R	K3, K4
CO6	Prepare reproducible reports using R Markdown and present data-driven conclusions	K6

COURSE CONTENT:

Module No.	Topics Covered	Duration (Hours)
Module 1	Introduction to R and RStudio, RStudio interface, basic syntax and operators	5 hours
	Variables, data types, writing and running basic R scripts	
Module 2	Data structures in R: vectors, matrices, lists, data frames, and factors	6 hours
	Indexing and subsetting data, importing/exporting data (CSV, Excel)	
	Handling missing data and basic data cleaning	
Module 3	Introduction to dplyr functions: filter, select, mutate, arrange	6 hours
	Grouping and summarizing data, using the pipe operator (%>%)	
	Introduction to tidyr: reshaping data formats (pivoting, gathering, spreading)	
Module 4	Introduction to ggplot2: grammar of graphics, creating basic plots (bar, scatter, histograms)	6 hours
	Customizing plots: themes, colors, labels, facetting	
Module 5	Descriptive statistics (mean, median, SD, variance), hypothesis testing (t-test, ANOVA)	7 hours
	Correlation and regression, plotting statistical results	

	Introduction to R Markdown, creating reports with embedded code and output	
Total		30 Hrs

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	2	1	1	2	1	1	1	2	3	1	1	1	1	1	1
CO-2	2	3	1	1	2	1	1	1	3	3	1	1	1	1	1	1
CO-3	1	2	2	1	1	1	1	1	1	2	1	1	1	1	1	1
CO-4	2	2	2	3	2	1	1	1	2	3	1	1	1	1	1	1
CO-5	2	2	1	2	3	1	1	1	2	3	1	1	1	1	1	1
CO-6	3	3	1	2	3	1	1	1	3	3	1	1	1	1	1	1

Enzymology (TIU-UBT-T313)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Metabolic Engineering	Subject Code: TIU-UBT-T313
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the classification, mechanism, and specificity of enzyme action.
2. Analyze enzyme kinetics and inhibition mechanisms for single-substrate reactions.
3. Explore enzyme immobilization techniques and their applications in biotechnology.
4. Apply enzyme engineering and recombinant technology for industrial and therapeutic applications.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Recall the classification, structure, and mechanism of enzyme action.	K1
CO-2	Explain enzyme kinetics, including Michaelis-Menten equation and inhibition mechanisms.	K2
CO-3	Analyze the role of allosteric enzymes and metabolic regulation in biological systems.	K4
CO-4	Demonstrate the principles of enzyme immobilization and its effect on catalysis.	K3
CO-5	Evaluate the impact of inhibitors, temperature, and pH on enzyme activity and stability.	K4

CO-6	Apply recombinant technology and chimeric enzyme approaches for industrial and medical applications.	K3
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COURSE CONTENT:

MODULE 1:	Introduction to metabolic engineering and its importance	20 Hours
Introduction to Metabolic Engineering, Basic concepts; Scopes and Applications; Introduction to metabolism, catabolism, anabolism. Key differences between metabolic controls of prokaryotes and eukaryotes. Metabolism Cellular Transport processes, Fueling Reactions. Cellular Metabolism Overview, Biosynthetic reactions, Polymerization, Growth Energetics, Regulation of Metabolic Pathways. classification, mechanism of enzyme action, active site determination, identification of binding and catalytic sites, specificity of enzyme action, activation energy and transition state theory, role of entropy in catalysis. Kinetics of single substrate enzyme catalyzed reactions, Michaelis-Menten equation, turnover number, enzyme inhibition- competitive, non-competitive, and uncompetitive, allosteric enzymes and metabolic regulation.		
MODULE 2:	Metabolic flux analysis	10 Hours
Flux Balance Analysis (FBA), Flux Variability Analysis, Flux Map, Experimental determination of metabolic fluxes C13 labeling, NMR and GC-MS based methods for flux determination.		
MODULE 3:	Application of metabolic Flux Analysis	15 Hours
Pathway engineering strategies for overproduction of some commercially important primary and secondary metabolites (e.g. amino acids, organic acids, alcohols and therapeutic compounds) or industrially relevant enzymes and recombinant proteins, bioconversion- applications and factors affecting bioconversion, mixed or sequential bioconversions, regulation of enzyme production, strain selection and improvement, the modification of existing or the introduction of entirely new metabolic pathways		
TOTAL LECTURES		45 Hours

Books:

Metabolic Engineering, Principles and Methodologies; G N Stephanopoulos, A A Aristidou, J Nielsen
 2. Advances in Biochemical Engineering/Biotechnology; Metabolic Engineering, Volume Editor: Jens Nielsen
 3. Systems Metabolic Engineering, Methods and Protocols; H S Alper
 4. Metabolic Pathway design, A Practical Guide; P Carbonell
 5. Metabolic Engineering: Principles and Methodologies by Gregory N. Stephanopoulos, Aristos A. Aristidou, and Jens Nielsen.
 6. Pathway Analysis and Optimization in Metabolic Engineering by Néstor V. Torres and Eberhard O. Voit.
 7. The Metabolic Pathway Engineering Handbook by Christina D. Smolke.
 8. Biochemical Engineering by Harvey W. Blanch and Douglas S. Clark.

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1	1
CO-2	3	3	2	2	2	1	1	1	1	2	1	1	3	2	1	1
CO-3	2	3	3	3	3	1	1	1	1	2	1	1	3	3	1	2
CO-4	2	2	2	3	3	1	1	1	1	2	1	1	3	2	1	2
CO-5	2	3	3	3	3	1	1	1	1	2	1	1	3	3	1	2

CO-6	3	2	2	3	3	1	1	1	1	2	2	1	3	3	2	3
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Industrial Biotechnology (TIU-UBT-T305)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title Industrial Biotechnology	Subject Code: TIU-UBT-T305
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles of microbial selection, screening, and strain improvement techniques.
2. Explore various fermentation processes, including submerged, surface, and solid-state fermentation.
3. Analyze industrial-scale production and purification of biotechnological products.
4. Apply biotechnology for the production of enzymes, biofuels, pharmaceuticals, and other industrially relevant products.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understanding Microorganism Selection: Demonstrate an understanding of the criteria for selecting microorganisms for biotechnological applications and the screening methods for metabolite production.	K1
CO-2	Explaining Strain Improvement Techniques: Explain various strain improvement techniques, including recombinant DNA technologies and site-directed mutagenesis, and their significance in enhancing microbial performance..	K2
CO-3	Describing Fermentation Systems: Describe different fermentation systems, including submerged, surface, and solid-state fermentation, and identify the raw materials used in each system.	K4
CO-4	Analyzing Solid Substrate Fermentation: Analyze the principles and applications of solid substrate fermentation (SSF) and surface fermentation, highlighting their advantages and disadvantages.	K3
CO-5	Identifying Enzyme Production Sources: Identify and differentiate between the production sources of enzymes from microbial, plant, and animal origins, including the processes involved in their purification and recovery.	K4

CO-6	CO6: Understanding Biogas and Biofuel Production: Understand the technologies involved in biogas and biofuel production, as well as the industrial processes for manufacturing key products such as wine, cheese, bread, vaccines, organic solvents, antibiotics, monoclonal antibodies, hormones, and cytokines.	K3
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COURSE CONTENT:

MODULE 1:		15 Hours
Selection of microorganism, screening for metabolites, strain improvement and various rDNA technologies for strain improvement including site directed mutagenesis.		
MODULE 2:		15 Hours
: Fermentation, raw materials for fermentation, submerged, surface and solid-state systems, whole cell and enzyme immobilized systems Solid substrate fermentation (SSF): Principles and application; Surface fermentation Comparison between SSF, Surface fermentation.		
MODULE 3:		15 Hours
Production of enzymes from microbial, plant and animal sources, purification and recovery of enzymes, biogas and biofuel production technology, industrial technology for manufacture of various industrially important products like wine, cheese, bread, vaccine, organic solvent, antibiotics, monoclonal antibody hormone and cytokines.		
TOTAL LECTURES		45 Hours

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	1	2	1	1	1	1	2	1	1	3	2	1	2
CO-2	3	3	2	2	3	1	1	1	1	3	1	1	3	3	1	2
CO-3	2	3	3	3	3	1	1	1	1	2	1	1	3	3	1	3
CO-4	2	3	3	3	3	1	1	1	1	2	1	1	3	3	1	3
CO-5	2	3	2	2	3	1	1	1	1	2	1	1	3	3	1	2
CO-6	3	3	3	3	3	1	1	1	1	3	2	1	3	3	1	3

Genetics and Biostatistics (TIU-UBT-T309)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Genetics and Biostatistics	Subject Code: TIU-UBT-T309
Contact Hours/Week: L-T-P: 2-0-2	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental principles of classical genetics, including inheritance patterns and chromosomal variations.
2. Explore microbial genetics, including plasmid biology, transformation, conjugation, and transduction mechanisms.
3. Apply statistical methods for data analysis in biological research.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the principles of Mendelian inheritance, gene interactions, and chromosome mapping.	K1
CO-2	Analyze chromosomal variations and their effects on inheritance patterns.	K2
CO-3	Demonstrate knowledge of microbial genetics, including plasmid transfer, transformation, and recombination mechanisms.	K3
CO-4	Apply genetic mapping techniques using bacterial transformation, conjugation, and transduction.	K3
CO-5	Perform statistical analysis, including mean, median, standard deviation, correlation, and regression, in biological data interpretation.	K4
CO-6	Evaluate the significance of experimental data using chi-square tests, t-tests, ANOVA, and p-value assessment.	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Classical Genetics: Mendelian inheritance, physical basis of inheritance, epistasis: gene interaction, multiple alleles, complementation, linkage, recombination and chromosome mapping, extrachromosomal inheritance, sex determination, special types of chromosomes. Chromosomal variations: numerical - euploidy and aneuploidy; structural - deletion, duplication, inversion and translocation.		
MODULE 2:		15 Hours
Microbial Genetics: Bacterial Genetics: plasmids: types, structure, copy number, transfer. Transformation-natural transformation systems, mechanism, gene mapping by transformation; chemical-mediated and electro-transformation, Conjugation-discovery, nature of donor strains and compatibility, interrupted mating and temporal mapping, Hfr, F12 heteroduplex analysis, chromosome transfer in other bacteria, molecular pathway of recombination, Transduction-Generalized and specialized transduction; gene mapping by transduction.		
MODULE 3:		15 Hours
Mean, Median, Mode, Standard Deviation and Error, Correlation and Regression, Chi-square, T-test, Goodness of Fit, p-value, ANOVA.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	2	1	1	1	1	1	1	1	1	3	3	2	1
CO-2	3	3	2	3	2	1	1	1	1	1	1	1	3	3	2	1
CO-3	3	3	3	3	3	1	1	1	2	2	1	1	3	3	2	2
CO-4	3	3	3	3	3	1	1	1	2	2	1	1	3	3	2	2
CO-5	2	3	2	3	3	1	1	1	2	2	1	1	3	3	2	2
CO-6	2	3	2	3	3	1	1	1	2	2	1	1	3	3	2	2

Animal Biotechnology (TIU-UBT-T311)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Animal Biotechnology	Subject Code: TIU-UBT-T311
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Comprehend the principles and techniques of animal cell culture, including laboratory setup and maintenance.
2. Understand various animal diseases, their diagnosis, and control strategies.
3. Explore stem cell technology, transgenic animal development, and their applications in biotechnology.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Understand the methodology of establishing and maintaining animal cell cultures.	K1
CO-2	Explain different types of cell cultures, cell separation techniques, and cytotoxicity assays.	K2
CO-3	Analyze animal diseases, their transmission, and methods for diagnosis and control.	K3
CO-4	Evaluate stem cell technology and micromanipulation techniques used in animal biotechnology.	K4
CO-5	Demonstrate knowledge of transgenic animal production, including gene modifications and cloning techniques.	K3
CO-6	Assess the ethical concerns and applications of transgenic animals in biotechnology.	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Animal cell culture, basic principles, Laboratory requirements for animal cell culture: Sterile handling area, Sterilization of different materials used in animal cell culture, Aseptic concepts, Instrumentation and equipments for animal cell culture, History of cell culture, Primary and secondary 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 2:		15 Hours
Animal diseases, diagnosis, therapy, variations of diseases, modes of transmission of diseases, control and management of disease spreading		
MODULE 3:		15 Hours
Stem cells, micromanipulation of embryos, generation of modified stem cells, transgenic animals, retroviruses and DNA microinjection method, transgenic mice, cattle, knock in and knock out animals, Importance of transgenic animals in biotechnology and ethical issues, valuable genes for animal biotechnology.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	2	1	1	2	1	1	1	1	2	1	1	3	2	1	2
CO-2	3	3	2	2	3	1	1	1	1	3	1	1	3	3	2	2
CO-3	3	3	3	3	3	1	1	1	1	3	1	1	3	3	3	3
CO-4	2	3	3	3	3	1	1	1	1	3	1	1	3	3	2	3
CO-5	2	3	3	3	3	1	1	1	1	3	1	1	3	3	3	3
CO-6	2	2	1	3	2	2	1	3	1	2	1	1	3	3	2	3

Bioseparation Technology and Downstream Processing (TIU-UBT-T307)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Bioseparation Technology and Downstream Processing	Subject Code: TIU-UBT-T307
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVES:

Enable the student to:

1. Understand the role and importance of bioseparation in biotechnological processes.

2. Explore various solid-liquid separation techniques, including membrane-based separation and chromatographic methods.
3. Analyze advanced bioseparation techniques such as crystallization, drying, and cost-effective downstream processing.
4. Develop logical problem-solving skills related to bioseparation challenges.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the importance of bioseparation in biotechnology and apply logical reasoning to problem-solving.	K1
CO-2	Demonstrate knowledge of cell disruption and solid-liquid separation methods, including filtration and centrifugation.	K2
CO-3	Analyze membrane-based separation techniques (MF, UF, RO) and their applications in biotechnology.	K4
CO-4	Evaluate different chromatographic methods (Gel Permeation, Ion Exchange, Affinity, HPLC, UPLC, GC) for bioprocess purification.	K4
CO-5	Apply principles of crystallization and drying in downstream processing of bioproducts.	K3
CO-6	Assess cost-cutting strategies and optimal methods for industrial bioseparation and product recovery.	K3

COURSE CONTENT:

MODULE 1:		15 Hours
Introduction to Bioseparation Technology, Role and importance of Bioseparation in biotechnological processes, Logic of Bioseparation Technology, Discussion of different live problems related to Bioseparation; students logical ability testing		
MODULE 2:		15 Hours
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.		
MODULE 3:		15 Hours
Liquid liquid extraction, Precipitation, Chromatographic Separation Techniques, Theory, Types. Gel Permeation, Ion Exchange, Affinity Chromatography, HPLC, UPLC, GC etc		
MODULE 4:		
Crystallization:- Principles-Nucleation- Crystal growth-Kinetics. Drying -Principles-Water in biological solids, Vacuum shelf and rotary 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

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	2	1	1	1	1	1	2	1	1	3	2	2	1
CO-2	3	3	2	3	3	1	1	1	1	3	1	1	3	3	2	2
CO-3	3	3	3	3	3	1	1	1	1	3	1	1	3	3	3	2
CO-4	3	3	3	3	3	1	1	1	2	3	1	1	3	3	3	2
CO-5	3	3	2	3	3	1	1	1	2	3	1	1	3	3	2	2
CO-6	3	3	2	3	3	1	1	1	2	3	1	1	3	3	2	2

Enzymology Laboratory (TIU-UBT-L315)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Enzymology Laboratory	Subject Code: TIU-UBT-L315
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles of enzyme kinetics and spectrophotometric analysis.
2. Analyze the effect of pH, temperature, and inhibitors on enzyme activity.
3. Perform isozyme assays and interpret enzyme behavior under different conditions.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Determine enzyme kinetic parameters using spectrophotometric methods.	K1
CO-2	Evaluate the effect of pH and temperature on enzyme activity.	K2
CO-3	Analyze enzyme inhibition mechanisms (competitive, uncompetitive, and non-competitive).	K3
CO-4	Perform isozyme assays and interpret their significance.	K3
CO-5	Apply enzyme kinetics concepts in biotechnological and industrial applications.	K4
CO-6	Develop experimental skills for enzyme characterization and analysis.	K4

COURSE CONTENT

Experiment 1:	Determination of enzyme kinetic parameters and Km and Vmax by spectrophotometric method	Total hours 45 HOURS
Experiment 2:	Demonstration of the effect of pH and temperature on enzyme activity.	

Experiment 3:	Study of inhibitors on enzymatic activity (competitive, uncompetitive, noncompetitive)	
Experiment 4:	Assay of Isozymes	

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	3	2	3	3	1	1	1	2	2	1	1	3	2	3	2
CO-2	2	3	2	2	2	1	1	1	1	2	1	1	3	2	2	2
CO-3	3	3	3	3	3	1	1	1	2	3	1	1	3	3	3	2
CO-4	3	2	2	3	3	1	1	1	2	3	1	1	3	2	3	2
CO-5	3	3	3	3	3	1	1	1	2	3	1	1	3	3	3	3
CO-6	3	3	3	3	3	1	1	1	2	3	1	2	3	3	3	3

Bioseparation Technology Laboratory (TIU-UBT-L317)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Bioseparation Technology Laboratory	Subject Code: TIU-UBT-L317
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand microbial fermentation processes for industrially important products.
2. Learn techniques for bioseparation and partial purification of biomolecules.
3. Develop practical skills in microbial analysis, antibiotic assay, and industrial fermentation.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Perform ethanol production from sugarcane juice and its partial purification.	K1
CO-2	Demonstrate wine production using a fermenter.	K2
CO-3	Analyze microbial contamination and quality of milk.	K3
CO-4	Conduct antibiotic production assays and study antibiotic resistance.	K3
CO-5	Apply bioseparation techniques for protein, carbohydrate, and lipid	K4

	extraction from complex mixtures.	
CO-6	Utilize fermentation and bioseparation principles in industrial biotechnology applications.	K4

COURSE CONTENT

Experiment 1:	Production of ethanol from sugarcane juice and its partial purification	45 HOURS
Experiment 2:	Demonstration of wine production in a fermenter	
Experiment 3:	Assay of antibiotic production and demonstration of antibiotic resistance	
Experiment 4:	Bioseparation of Protein from a complex mixture	
Experiment 5:	Bioseparation of Carbohydrate and Lipid from a complex mixture	
Experiment 6:	Separation of amino acids using chromatography	

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	2	2	2	1	1	1	2	2	1	1	3	2	2	2
CO-2	3	2	2	2	2	1	1	1	2	2	1	1	3	3	2	2
CO-3	3	3	2	3	3	2	1	2	2	3	1	1	3	3	3	3
CO-4	3	3	3	3	3	2	1	2	2	3	1	1	3	3	3	3
CO-5	3	3	3	3	3	1	1	1	2	3	1	2	3	3	3	3
CO-6	3	3	3	3	3	1	1	1	2	3	2	2	3	3	3	3

Career Advancement and Skill Development (Biocomputing I) (TIU-UBT-S301)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 5th Sem.
Course Title: Career Advancement and Skill Development (Biocomputing I)	Subject Code: TIU-UBT-S301
Contact Hours/Week: L-T-P: 2-0-2	Credit: 3

Course objectives

1. To introduce students to the fundamental concepts of bioinformatics.
2. To familiarize students with biological databases and computational tools for sequence analysis.
3. To develop skills in analyzing biological sequences using bioinformatics algorithms.
4. To provide an understanding of molecular phylogenetics and structural bioinformatics.
5. To introduce basic programming and scripting techniques for bioinformatics applications.

CO Number	Course Outcome Statement	Knowledge Level (K)
CO1	Recall the scope and key applications of bioinformatics in biotechnology and medicine.	K1
CO2	Describe various biological databases and data retrieval tools such as NCBI, EMBL, and Uniprot.	K2
CO3	Apply knowledge to access and extract data from nucleotide and protein databases using appropriate formats.	K3
CO4	Analyze sequence data using pairwise and multiple sequence alignment techniques and interpret the results.	K4
CO5	Construct phylogenetic trees using software tools and justify the choice of alignment and scoring methods.	K4
CO6	Demonstrate proficiency in molecular visualization tools to interpret protein structure and functional domains.	K3

Course content

MODULE 1:	Introduction to Bioinformatics	30 Hours
Overview and scope of bioinformatics. Role of computers in biological research		
Bioinformatics applications in biotechnology and medicine. Biological data and types of biological databases. Introduction to data retrieval tools (NCBI, EMBL, DDBJ, Uniprot, PDB, etc.)		
MODULE 2:	Biological Databases & Data Retrieval	30 Hours
Nucleotide sequence databases (GenBank, EMBL, DDBJ). Protein sequence databases (SwissProt, TrEMBL, PIR). Structural databases (PDB, MMDB, CATH, SCOP). Literature databases (PubMed, OMIM). File formats: FASTA, GenBank, PDB. Sequence submission tools (BankIt, Sequin)		
MODULE 3:	Sequence Alignment and Phylogenetics	30 Hours
Concept of sequence alignment. Pairwise sequence alignment (Needleman-Wunsch, Smith-Waterman algorithms). Multiple sequence alignment (Clustal Omega, MUSCLE, T-Coffee). Scoring matrices (PAM, BLOSUM). Phylogenetic tree construction (Neighbor-Joining, Maximum Likelihood, UPGMA). Phylogenetic tools (MEGA, PhyML). Introduction to bioinformatics tools (BLAST, FASTA, HMMER) Molecular visualization tools (RasMol, PyMOL, Chimera)		
TOTAL LECTURES		90 Hours

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
C01	3	2	1	1	2	1	1	1	1	1	1	2	2	2	3	2
C02	3	3	2	2	3	1	1	1	1	2	1	2	3	3	3	2
C03	3	3	2	2	3	1	1	1	2	2	1	2	3	3	3	3
C04	3	3	3	3	3	1	1	1	2	2	1	3	3	3	3	3
C05	3	3	3	3	3	1	1	1	2	2	1	3	3	3	3	3
C06	3	3	3	3	3	1	1	1	2	2	1	2	3	3	3	3

Plant Biotechnology (TIU-UBT-T314)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Plant Biotechnology	Subject Code: TIU-UBT-T314
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental principles of plant tissue culture and somatic cell genetics.
2. Learn plant regeneration pathways and advanced techniques like somatic embryogenesis, cryopreservation, and protoplast fusion.
3. Explore genetic transformation techniques and marker-assisted breeding for crop improvement.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the principles of plant tissue culture and media preparation.	K1
CO-2	Perform micropropagation, callus initiation, and suspension cultures.	K2
CO-3	Describe organogenesis, somatic embryogenesis, and haploid production techniques.	K3
CO-4	Demonstrate protoplast culture, somatic hybridization, and secondary metabolite production.	K3
CO-5	Apply gene transfer methods (Agrobacterium, gene gun, etc.) for transgenic crop development.	K4
CO-6	Utilize molecular markers for genome mapping and marker-assisted breeding.	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Plant tissue culture and somatic cell genetics: Introduction to plant tissue culture: Tissue culture Media; Initiation and maintenance of callus and suspension cultures; single cell clones, micropropagation (production of pathogen free plants).		
MODULE 2:		15 Hours
Plant regeneration pathways–Organogenesis and Somatic embryogenesis; Endosperm culture and triploid production; Anther and pollen culture, and production of haploid and doubled haploid plants; Protoplast culture and fusion, Somatic hybrids; Organelle transfer and cybrids, hairy root culture and secondary metabolites, cryopreservation and production of synthetic seeds.		
MODULE 3:		15 Hours
Gene transfer (Agrobacterium and Ti plasmid and gene gun), Pseudomonas, and transgenic crop development. Marker assisted breeding; Introduction - molecular markers as new efficient tools in breeding, Molecular markers for genome mapping: development and choice of mapping populations, linkage map construction.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	--	2	--	1	1	--	--	--	1	3	2	--	2
CO-2	2	2	3	2	2	--	1	1	2	1	2	2	3	2	--	3
CO-3	2	2	3	2	2	1	1	1	1	--	1	2	3	2	--	2
CO-4	2	2	2	3	2	--	1	1	2	1	2	2	3	2	--	3
CO-5	2	3	3	3	3	2	2	2	2	1	2	3	3	3	2	3
CO-6	2	3	2	3	3	2	2	2	1	1	2	3	3	3	3	2

Regulation of Gene Expression (TIU-UBT-T318)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Regulation of Gene Expression	Subject Code: TIU-UBT-T318
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the regulation of gene expression in prokaryotic and eukaryotic systems.
2. Analyze the role of epigenetic mechanisms in gene regulation.
3. Apply molecular techniques to study and interpret gene regulation patterns.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the regulation of gene expression in prokaryotic systems, including the lac, trp, and ara operons.	K2
CO-2	Describe the molecular mechanisms involved in phage and yeast gene regulation.	K2
CO-3	Analyze epigenetic modifications such as histone modifications, enhancers, and silencers.	K4
CO-4	Utilize molecular techniques like qPCR, ChIP, and Western Blotting for gene regulation studies.	K3
CO-5	Interpret experimental data from assays such as gel retardation, primer extension, and ELISA.	K3
CO-6	Compare and evaluate different gene regulation techniques and their applications in research.	K3

COURSE CONTENT:

MODULE 1:		15 Hours
Regulation of Prokaryotic Transcription and Translation: Lessons from bacteria; lac, trp, and ara operons; control of lysis and lysogeny in lambda phage; gene regulation in yeast - gal operon.		
MODULE 2:		15 Hours
Epigenetic control mechanisms: Histone modifying enzymes and their functions, enhancers, silencers, MNase Digestion.		
MODULE 3:		15 Hours
Techniques: Gel retardation assays, reporter gene assays, primer extension, S1 nuclease mapping assays, DNA fingerprinting, qPCR/RT-PCR, Y-2-H, Phage Display, Co-IP, ChIP, Western Blotting, ELISA, Microarray, Flowcytometry, SAGE.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	3	2	2	2	1	1	1	--	--	--	2	3	2	--	1
CO-2	3	3	2	2	2	1	1	1	--	--	--	2	3	3	--	1
CO-3	3	3	2	3	2	2	2	1	1	--	--	3	3	3	2	2
CO-4	3	3	3	3	3	2	1	1	1	2	1	3	3	2	3	3
CO-5	2	3	2	3	3	2	2	1	1	2	1	3	3	2	3	3
CO-6	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3

Food and Pharmaceutical Biotechnology (TIU-UBT-T324)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Food and Pharmaceutical Biotechnology	Subject Code: TIU-UBT-T324
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

1. Understand Food Chemistry and Preservation Techniques
2. Develop Competency in Food Quality Control and Regulatory Standard
3. Explore Pharmaceutical Biotechnology and Drug Development

Course Outcomes

CO Number	Course Outcome	Knowledge k Level
CO1	Recall the structure, sources, and roles of carbohydrates, proteins, fats, vitamins, and minerals in food.	K1
CO2	Describe various methods of food preservation and explain their scientific principles and significance.	K2
CO3	Apply the principles of quality control and management to ensure food safety and regulatory compliance.	K3
CO4	Analyze pharmacokinetic and pharmacodynamic properties of drugs and interpret their therapeutic impact.	K4
CO5	Evaluate drug design strategies and explain the principles behind pharmacophores and structure-based drug discovery.	K4
CO6	Compare herbal and conventional drugs, and discuss their bioactive components and therapeutic applications.	K3

COURSE CONTENT:

MODULE 1:	20 Hours
FOOD CHEMISTRY and PRINCIPLES OF FOOD PRESERVATION: Food, Introduction to different food groups and importance of food chemistry. Carbohydrates: Sources of food carbohydrates; Physico-chemical and functional properties; chemistry and structure of homosaccharides and heterosaccharides. Proteins: Sources and physico-chemical and functional properties; Purification of proteins; Common food proteins. Fats: Sources and physico-chemical and functional properties; PUFA [Polyunsaturated Fatty Acids] hydrogenation and rancidity; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Lipids of biological importance like cholesterol and phospholipids. Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Pro vitamins A & D; Vitamins as antioxidants. Food Pigments & Flavoring Agents: Importance, types and sources of pigments – their changes during processing and storages.	

Introduction to food preservation – Objectives and techniques of food preservation. Canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods. Water activity of food and its significance in food preservation; dehydration and drying of food items; IMF; Low temperature preservation; Ionization radiation; Use of preservatives in foods: chemical preservatives, bio-preservatives, antibiotics, lactic acid bacteria. Enzymatic browning in foods: Mechanism, prevention, and implications in food quality. Fermented foods and their applications: Types, benefits, and role in food industry. Prebiotics, Probiotics, and Postbiotics: Definition, types, health benefits, and applications. Medicinal foods: Concept, types, and therapeutic roles.

MODULE 2:	8 Hours
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QUALITY CONTROL & MANAGEMENT:

Definition of quality, Quality specifications and quality attributes of different foods, Statistical quality control. Quality control programs: History and development, Total quality control and management, Quality assurance, ISO 9000 series. Food laws and regulations: PFA, FPO, MFPO, Essential Commodities Act, Sugarcane (Control) Order, FSSA. Food Safety Management Systems: HACCP, ISO 22000, ISO 17025.

MODULE 3:	8 Hours
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Basic

Pharmacology:

General Pharmacological Principle; Definition, Routes of drug administration; Pharmacokinetics: Transport through biological membrane; Basic concept of ADME; Pharmacodynamics: Principle of drug action, Mechanism of drug action, Factors modifying drug action; Adverse drug effects.

MODULE 4:	9 Hours
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Drug Designing:

Fundamentals of drug designing, The Pharmacophore, The Drug Discovery: Combinatorial Chemistry, Structure-based design, QSAR and drug design. **Herbal Drug Development:** Introduction to natural products, definition and types of principle bioactive components, Antioxidant Redox Signalling and Cellular Longevity. Benefits of herbal drugs over other therapeutic approaches. Current research on herbal drug development.

TOTAL LECTURES	45 Hours
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CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	--	1	2	2	1	--	--	--	1	3	2	1	1
CO-2	2	3	2	1	2	2	2	1	--	--	1	2	3	2	2	2
CO-3	2	3	3	2	2	2	2	1	1	1	2	2	3	3	2	3
CO-4	2	3	2	3	2	2	1	1	--	1	1	2	3	3	2	2
CO-5	3	3	2	3	3	2	1	1	--	1	2	3	3	3	3	2
CO-6	2	2	2	2	2	2	2	2	1	2	1	2	3	3	2	2

Molecular Diagnostics (TIU-UBT-T326)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Molecular Diagnostics	Subject Code: TIU-UBT-T326

Contact Hours/Week: L-T-P: 3-0-0	Credit: 3
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COURSE OBJECTIVE:

Enable the student to:

- 1) Describe the fundamental molecular biology ideas that are pertinent to diagnostics.
- 2) Explain the structure, function, and role of nucleic acids (DNA, RNA) in the detection of disease.
- 3) Comprehend the methods for sample extraction, preparation, and quality assurance.
- 4) Describe how molecular diagnostics are used in genetic disorders, cancer, infectious illnesses, and personalized treatment.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Recall fundamental concepts of medical biotechnology, including human physiology, disease classification, and their causes	K1
CO-2	Explain the principles and applications of biochemical and molecular diagnostic techniques such as PCR, Microarray, ELISA, and HPLC.	K2
CO-3	Describe various prenatal diagnostic techniques, including invasive (Amniocentesis, CVS, Fetoscopy) and non-invasive methods (Ultrasonography, X-ray, TIFA).	K2
CO-4	Analyze the interpretation of biochemical tests (Liver function test, Kidney function test, Blood sugar test, Hormone assay) for disease diagnosis.	K4
CO-5	Apply molecular therapy approaches, including gene therapy, RNA-based therapeutics, enzyme therapy, and monoclonal antibody therapy, for disease treatment.	K3
CO-6	Compare different advanced therapeutic approaches such as stem cell therapy and regenerative medicine for medical applications.	K4

COURSE CONTENT:

MODULE 1:	11 Hours
An introduction to medical biotechnology: 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.	
MODULE 2:	15 Hours
Biochemical and Molecular Diagnostics: Different biochemical test using protein and enzyme markers and their interpretation. e.g. Liver function test, kidney function test, blood sugar test, hormone assay etc. Molecular diagnostics: PCR based detection, Microarray, Protein profiling by HPLC, FACS, ELISA. Prenatal diagnosis - 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:	19 Hours

Molecular therapy: Gene therapy: 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
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CO-PO-PSO MAPPING

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	1	--	1	2	2	1	--	--	--	1	2	3	--	1
CO-2	3	3	2	2	3	2	1	1	--	1	1	2	3	3	2	2
CO-3	2	3	2	2	2	2	2	1	--	--	1	2	2	3	2	2
CO-4	3	3	2	3	2	2	1	1	1	1	2	2	2	3	2	3
CO-5	3	3	3	2	3	2	2	1	1	2	2	3	3	3	3	3
CO-6	2	3	2	3	2	2	2	2	1	2	2	3	3	3	2	3

Bioanalytical Techniques Laboratory (TIU-UBT-L328)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Bioanalytical Techniques Laboratory	Subject Code: TIU-UBT-L328
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and applications of bioanalytical techniques.
2. Develop hands-on skills in protein, lipid, and amino acid analysis.
3. Apply spectroscopic and chromatographic methods for biochemical analysis.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Perform native and SDS-PAGE electrophoresis for protein separation.	K3
CO-2	Prepare sub-cellular fractions from rat liver cells for biochemical analysis.	K3
CO-3	Isolate and prepare protoplasts from plant leaves for further studies.	K3
CO-4	Separate and identify amino acids using paper chromatography.	K3
CO-5	Analyze lipid components in biological samples using Thin Layer Chromatography (TLC).	K3

CO-6	Verify Beer's Law and determine the molar extinction coefficient of biomolecules like NADH.	K3
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Course Content

Experiment No.	Title	42 HOURS
1	Native Gel Electrophoresis of Proteins	
2	SDS-PAGE of Proteins under Reducing Conditions	
3	Preparation of Sub-cellular Fractions from Rat Liver Cells	
4	Preparation of Protoplasts from Leaves	
5	Separation of Amino Acids by Paper Chromatography	
6	Identification of Lipids in a Given Sample by TLC	
7	Verification of Beer's Law and Determination of Molar Extinction Coefficient of NADH	

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	2	3	3	3	1	--	1	2	2	1	2	3	2	2	3
CO-2	2	2	2	3	3	1	--	1	2	1	2	2	3	2	2	3
CO-3	2	2	3	2	2	--	1	1	2	1	1	2	2	2	2	3
CO-4	2	2	2	2	2	--	1	1	1	1	1	2	2	1	2	2
CO-5	2	2	2	2	2	1	1	1	1	1	1	2	2	2	2	2
CO-6	3	2	2	2	2	--	--	1	1	1	1	2	3	2	2	2

Plant Biology Laboratory (TIU-UBT-L316)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Plant Biology Laboratory	Subject Code: TIU-UBT-L316
Contact Hours/Week: L-T-P: 0-0-3	Credit: 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamental techniques in plant tissue culture.
2. Develop skills in the culture and propagation of plant tissues.
3. Analyze plant-derived bioactive compounds using biochemical techniques.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Select and prepare explants for plant tissue culture, including sterilization and inoculation techniques.	K3
CO-2	Develop and maintain callus and suspension cultures for plant propagation.	K3
CO-3	Perform anther and pollen culture to generate haploid plants.	K3
CO-4	Understand and apply different plant culture techniques for large-scale propagation.	K3
CO-5	Analyze and estimate biologically important plant metabolites using biochemical assays.	K4
CO-6	Interpret experimental data and troubleshoot common issues in plant tissue culture.	K4

Course Content:

Experiment 1:	Preparation of MS media	42 HOURS
Experiment 2:	Explant selection, sterilization and inoculation	
Experiment 3:	Callus culture from meristematic tissue and induction of growth,	
Experiment 4:	Cell suspension culture from induced callus	
Experiment 5:	Establishment of Anther/Pollen culture	
Experiment 6:	Establishment of Shoot tip culture	

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	2	3	2	3	1	1	1	2	1	1	2	3	2	2	3
CO-2	2	2	3	2	3	1	1	1	2	1	1	2	3	2	2	3
CO-3	2	2	3	2	2	1	--	1	2	1	1	2	3	2	1	3
CO-4	2	2	3	2	2	1	2	1	2	1	1	2	3	2	2	3
CO-5	3	2	2	3	2	--	1	1	1	1	1	2	3	2	2	3
CO-6	3	2	2	3	2	--	--	1	2	2	2	3	3	2	2	3

Career Advancement and Skill Development (Biocomputing II) (TIU-UBT-S302)

Program: B. Tech. in Biotechnology	Year, Semester: 3rd Yr. 6th Sem.
Course Title: Career Advancement and Skill Development (Biocomputing II)	Subject Code: TIU-UBT-S302
Contact Hours/Week: L-T-P: 1-0-2	Credit: 2

Course objectives

1. Understand Advanced Bioinformatics Tools & Algorithms

Introduce students to computational techniques for biological data analysis, including sequence alignment, molecular modeling, and phylogenetic analysis.

2. Develop Skills in Genomic & Proteomic Data Analysis

Equip students with hands-on experience in analyzing genomic, transcriptomic, and proteomic datasets using bioinformatics software and databases.

3. Apply Computational Methods for Biological Problem-Solving

Enable students to use computational approaches for drug discovery, structural biology, and systems biology applications in biotechnology.

Course Outcomes:

CO Number	Course Outcome Statement	Knowledge Level
CO1	Recall the applications and categories of biological databases relevant to genomics, proteomics, and metabolomics.	K1
CO2	Explain the principles of next-generation sequencing (NGS) and RNA sequencing analysis workflows.	K2
CO3	Apply protein modeling and molecular docking techniques for structural bioinformatics applications.	K3
CO4	Analyze protein functions using molecular dynamics simulations and functional annotation tools.	K4
CO5	Evaluate genomic and transcriptomic data using techniques such as genome assembly, RNA-Seq, and microarrays.	K4
CO6	Interpret mass spectrometry-based proteomics data and construct protein-protein interaction networks.	K3

Course content

MODULE 1:	Introduction to Advanced Bioinformatics	10 Hours
Overview of bioinformatics & its applications. Biological databases: Genomic, proteomic, and metabolomic databases. Next-generation sequencing (NGS) data analysis. RNA sequence analysis.		
MODULE 2:	Structural Bioinformatics	10 Hours
Protein structure prediction and modeling (Homology modeling, Ab initio, Molecular Docking). Molecular dynamics simulations. Functional annotation of proteins. Structure-based drug design. Molecular docking and virtual screening.		
MODULE 3:	Genomics & Transcriptomics	10 Hours
Whole-genome sequencing and genome assembly techniques. RNA-Seq data analysis and transcriptome profiling. Microarray data analysis and interpretation. Mass spectrometry-based proteomics. Protein-protein interaction networks		
TOTAL LECTURES		30 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	3	2	2	--	2	1	1	--	-	--	--	1	3	2	3	--
CO-2	3	3	2	2	3	1	1	1	-	1	--	2	3	2	3	2
CO-3	2	3	3	3	3	1	1	1	1	1	1	2	3	2	3	2
CO-4	3	3	2	3	3	1	1	1	1	1	1	3	3	2	3	3
CO-5	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3	3
CO-6	3	3	2	3	3	2	1	1	1	1	2	3	3	3	3	3

Career Advancement & Skill Development ([Gene Expression and Transgenics](#))(TIU-CASD-UBT-S497)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 7th Sem.
Course Title: Career Advancement & Skill Development (Gene Expression and Transgenics)	Subject Code: TIU-CASD-UBT-S497
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

Course objective:

1. To develop analytical and communication skills through structured journal club presentations and scientific discussions.
3. To enable students to critically evaluate and interpret research papers from reputed journals.
4. To train students in basic teaching methodologies, including content development, lesson planning, and classroom delivery.
5. To enhance confidence in academic presentations, peer engagement, and professional articulation.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Understand gene structure, regulation, and promoter characteristics essential for gene expression in prokaryotic and eukaryotic systems.

CO2: Apply principles of recombinant DNA technology to construct and evaluate expression vectors.

CO3: Analyze and compare various gene transfer methods in plants and animals for generating transgenic organisms.

CO4: Demonstrate techniques for selection and molecular confirmation of transgenic organisms using PCR and blotting methods.

CO5: Design strategies for the development, selection, and analysis of GMOs in compliance with regulatory and biosafety standards.

CO6: Critically evaluate experimental designs and trials for transgenic organisms with awareness of ethical, environmental, and societal impacts.

Course Content:

	Course Content	Contact Hours
Module 1	Gene Structure and Expression Mechanism <ul style="list-style-type: none">Structure of a gene: promoter, enhancer, coding sequence, terminatorRegulation of gene expression in prokaryotes and eukaryotesPromoter analysis and transcriptional regulationTypes of promoters: constitutive, inducible, and tissue-specificReporter genes: GUS, GFP, and Luciferase	15
Module 2	Vector Construction and Cloning Techniques <ul style="list-style-type: none">Basics of DNA cloning and restriction enzyme digestionCloning vectors: plasmids, cosmids, phagemids, BACs, and YACsExpression vectors for plants and animalsConstruction of plant and animal expression cassettesSelectable marker genes and reporter genesTransformation and screening strategies for recombinant clones	15
Module 3	<ul style="list-style-type: none">Gene transfer techniques: Agrobacterium-mediated transformation, electroporation, microinjection, gene gunSelection of transformants and confirmation of gene integrationPCR and Blotting techniques (Southern, Northern, Western)Generation and screening of transgenic plants and animalsBiosafety regulations, field trials, and risk assessment of	15

	GMOs <ul style="list-style-type: none"> • Ethical and regulatory considerations of transgenics 	
TOTAL		45

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	3	2	2	2	1	--	1	1	2	1	2	2	2	--	2
CO-2	3	3	2	3	2	1	--	1	--	1	1	3	2	2	1	2
CO-3	2	2	3	2	2	1	--	1	2	3	2	2	2	2	1	2
CO-4	1	1	2	1	2	2	--	2	3	3	2	2	2	2	--	3
CO-5	2	2	2	2	2	2	1	2	2	3	2	3	2	2	1	3
CO-6	2	2	1	2	1	2	--	2	3	3	2	3	2	2	--	3

Biosafety, Bioethics and IPR (TIU-UBT-T407)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 7th Sem.
Course Title: Biosafety, Bioethics and IPR	Subject Code: TIU-UBT-T407
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and significance of biosafety, bioethics, and regulatory practices in biotechnology.
2. Develop expertise in Good Laboratory Practices (GLP), Good Documentation Practices (GDP), and Good Clinical Practices (GCP).
3. Analyze intellectual property rights (IPR) and their relevance to biotechnological innovations.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the fundamentals of biosafety, bioethics, and their importance in laboratory research and industry.	K2
CO-2	Apply the principles of Good Laboratory Practices (GLP) to ensure	K3

	quality and reliability in biotechnological research.	
CO-3	Demonstrate proficiency in Good Documentation Practices (GDP) for regulatory compliance in research and industrial settings.	K3
CO-4	Describe the principles of Good Clinical Practices (GCP) and their role in ethical clinical trials and patient safety.	K2
CO-5	Analyze the importance of intellectual property rights (IPR) and their implications for biotechnology innovations.	K4
CO-6	Evaluate the patentability of biotechnological inventions based on intellectual property laws.	K4

COURSE CONTENT:

MODULE 1:		15 Hours
Introduction of Biosafety and bioethics. Good laboratory practices. History, Principles and applications of GLP in fundamental research and industry.		
MODULE 2:		15 Hours
Good documentation practice: principles of Good Documentation Practices and their importance in regulatory compliance. Significance of GDP in regulatory industries. GDP guidelines to prepare, review, and maintain documentation (e.g., lab reports, batch records).		
MODULE 3:		15 Hours
MODULE 4:		15 Hours
Introduction of intellectual property right, forms of intellectual property protection relevant to biotechnology, including patents, copyrights, and trademarks. intellectual property laws to analyze the patentability of biotechnological inventions.		
TOTAL LECTURES		45 Hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO-1	2	1	1	1	1	3	3	3	1	2	1	2	3	2	1	3
CO-2	3	3	2	2	3	2	2	2	2	2	2	2	3	2	1	3
CO-3	2	1	2	1	3	1	1	1	2	3	2	1	3	2	1	3
CO-4	1	1	2	1	1	3	2	3	1	2	1	1	1	3	1	2
CO-5	1	1	3	2	1	3	1	3	1	3	2	1	1	3	2	1
CO-6	1	1	3	2	1	3	1	3	1	3	2	1	1	3	2	1

Methods in Biology (TIU-UBT-T417)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 7th Sem.
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Course Title: Methods in Biology	Subject Code: TIU-UBT-T417
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and applications of electrophoresis, blotting, chromatography, and mass spectrometry.
2. Gain expertise in PCR-based techniques and gene expression analysis.
3. Develop hands-on skills in DNA sequencing, labeling, and cell culture techniques.

COURSE OUTCOME:

CO No.	Course Outcome	Knowledge Level (K)
CO-1	Explain the principles of electrophoresis, blotting, and their role in biomolecular separation.	K2
CO-2	Apply chromatographic techniques and mass spectrometry for biomolecule analysis.	K3
CO-3	Perform PCR-based techniques (RT-PCR & qPCR) to monitor gene expression.	K3
CO-4	Demonstrate DNA labeling and sequencing techniques for genetic analysis.	K3
CO-5	Establish and maintain plant and animal cell cultures for experimental applications.	K4
CO-6	Evaluate different bioanalytical techniques for their relevance in molecular and cellular biology research.	K4

Course content

MODULE	COURSE CONTENT	CONTACT HOURS
MODULE 1	Introduction to Real-Time PCR (qPCR): principles, instrumentation, reaction setup, amplification plots, quantification and analysis. DNA Microarray: principle of hybridization, probe design, array printing, scanning, data normalization and expression profiling.	8 HOURS
MODULE 2	2D Gel Electrophoresis: protein extraction, isoelectric focusing, SDS-PAGE, visualization and analysis. Mass Spectrometry (MS-MS): basics of MALDI-TOF, ESI-MS, tandem MS, peptide mapping, applications in proteomics.	7 HOURS
MODULE 3	High Performance Liquid Chromatography (HPLC): principles, types (RP, ion-exchange), instrumentation, applications in biomolecule separation. Immunotechnology: ELISA, Western blot, monoclonal antibody production, antigen-antibody interactions.	7 HOURS

MODULE 4	Electrophoresis Techniques: agarose gel electrophoresis, polyacrylamide gel electrophoresis (PAGE), pulse field gel electrophoresis. Blotting and Hybridization Techniques: Southern, Northern, Western blots; probe labeling, hybridization, detection.	7 HOURS
MODULE 5	DNA Sequencing and Labelling: Sanger and NGS methods, radioactive and non-radioactive probe labeling. Omics Tools: overview of genomics, transcriptomics, proteomics and metabolomics technologies.	8 HOURS
MODULE 6	Cell Culture Techniques: principles and protocols for plant tissue culture and animal cell culture, aseptic handling, media preparation. Single Cell Analysis: introduction to single-cell RNA sequencing, single-cell PCR, microfluidics.	8 HOURS
Total		45 hours

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	2	2	2	1	2	2	3	3	2	2	2	2	2
CO2	3	3	2	2	2	1	1	1	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	3	2	3	3	2	3
CO4	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3	3
CO5	3	3	2	2	2	2	1	2	2	2	2	3	3	3	3	3
CO6	2	2	2	2	2	1	1	2	3	3	2	2	2	2	2	2

Project Work-1 ([TIU-UBT-P491](#))

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 7th Sem.
Course Title: Project Work-1	Subject Code: TIU-UBT-P491
Contact Hours/Week: L-T-P: 0-0-8	Credit: 4

Course Objective

By the end of this course, the students will be able to:

1. Apply theoretical knowledge of biotechnology in real-world problem-solving through research or industrial experience.
2. Develop planning, experimental, analytical, and interpretative skills.
3. Enhance scientific and technical writing skills through report preparation.
4. Gain exposure to professional work environments, ethics, and interdisciplinary teamwork.
5. Understand current trends, tools, and technologies relevant to the biotechnology sector.

Course Outcomes:

CO Number	Course Outcome Statement	Knowledge Level
CO1	Explain the research or internship process and define clear project objectives, deliverables, and timelines.	K2
CO2	Conduct an in-depth literature survey or technical review to frame relevant research or industrial queries.	K3
CO3	Design and implement experiments or industrial tasks based on well-structured methodologies.	K3
CO4	Analyze experimental or collected data using appropriate statistical or analytical tools.	K4
CO5	Interpret findings to draw logical conclusions and troubleshoot problems arising during execution.	K4
CO6	Prepare a comprehensive technical report and deliver oral presentations with clarity and professionalism.	K3

Course content

Module	Course Content
Module 1	Project/Internship Orientation & Objective Setting <ul style="list-style-type: none"> - Introduction to research/internship process - Identification of supervisor (academic/industry) - Defining goals, objectives, expected outcomes, and deliverables
Module 2	Execution Phase <ul style="list-style-type: none"> - Literature survey / Technical review - Research design or Industry process understanding - Data collection/experiment/in-plant training - Regular progress reviews and logbook maintenance
Module 3	Analysis & Interpretation <ul style="list-style-type: none"> - Data analysis and visualization - Troubleshooting and optimization - Interpretation of results - Application of analytical/statistical tools (as applicable)
Module 4	Report Writing and Presentation <ul style="list-style-type: none"> - Final report/thesis preparation - Presentation to academic panel/industry mentors - Viva voce and feedback collection

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	1	1	1	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3	3

CO5	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3	3	3
CO6	2	2	2	2	2	2	1	2	3	3	2	2	2	2	2	2	2

Training/INTERNSHIP (TIU-UES-S403)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 7th Sem.
Course Title: Training/INTERNSHIP	Subject Code: TIU-UES-S403
Contact Hours/Week: L-T-P: 0-0-6	Credit: 3

Course objectives:

1. To expose students to real-world industrial/research environments in biotechnology and allied fields.
2. To familiarize students with practical workflows, instrumentation, SOPs, and regulatory procedures.
3. To enhance employability skills through experiential learning and mentorship.
4. To develop reporting, data analysis, and technical communication skills.

Course Outcomes:

CO Number	Course Outcome Statement	Knowledge Level
CO1	Describe the structure, expectations, and objectives of industrial/research training programs.	K2
CO2	Demonstrate the ability to engage professionally during field or virtual industrial exposure.	K3
CO3	Record and maintain structured observations and logbooks as per institutional norms.	K2
CO4	Identify and explain operational processes across departments such as R&D, QC, and diagnostics.	K3
CO5	Analyze field-based observations and correlate them with academic knowledge.	K4
CO6	Compile and present a detailed training report with clarity and respond effectively in viva voce.	K4

Course Content

Module	Course Content	Hours
Module 1	Training Orientation and Goal Setting: Overview of training objectives and roles, assigning industries/research labs, understanding institutional guidelines for training reports/logbooks	6
Module 2	Field/Industrial Exposure and Practical Learning: On-site/virtual interaction and shadowing, process understanding (R&D, QC, production, diagnostics), daily logbook and observation records	18

Module 3	Report Writing and Review Presentation: Preparation of final report, presentation and viva by internal/external faculty	6
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	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	1	1	2	1	1	2	2	2	2	2	2	1	2
CO2	2	2	2	2	2	3	2	2	3	2	2	2	2	2	2	3
CO3	2	1	1	1	2	1	1	2	2	2	2	2	1	1	1	2
CO4	3	3	2	2	2	2	2	2	2	2	2	2	3	3	2	3
CO5	3	3	2	3	3	2	1	2	2	2	2	3	3	3	3	3
CO6	2	2	2	2	2	2	1	2	3	3	2	2	2	2	2	2

Project Work-II (TIU-UBT-P492)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 8th Sem.
Course Title: Project Work-II	Subject Code: TIU-UBT-P492
Contact Hours/Week: L-T-P: 0-0-16	Credit: 8

Course Objective

By the end of this course, the students will be able to:

1. Apply theoretical knowledge of biotechnology in real-world problem-solving through research or industrial experience.
2. Develop planning, experimental, analytical, and interpretative skills.
3. Enhance scientific and technical writing skills through report preparation.
4. Gain exposure to professional work environments, ethics, and interdisciplinary teamwork.
5. Understand current trends, tools, and technologies relevant to the biotechnology sector.

Course Outcomes:

CO Number	Course Outcome (CO)	Knowledge Level
CO1	Understand the fundamental concepts of research and internship processes including goal setting and supervision.	K2
CO2	Conduct literature surveys or technical reviews relevant to the chosen topic to frame the scope of the project.	K3
CO3	Design and execute experiments or industry-relevant tasks with appropriate tools, methods, and documentation.	K4
CO4	Analyze and interpret experimental or industrial data using statistical and analytical tools.	K4
CO5	Troubleshoot issues encountered during the project execution and optimize methodologies for better outcomes.	K4
CO6	Compile project findings into a structured report and deliver an effective presentation to a scientific or industrial	K3

audience.

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	1	1	1	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3
CO4	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3	3
CO5	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3	3
CO6	2	2	2	2	2	2	1	2	3	3	2	2	2	2	2	2

Career Advancement & Skill Development (IoT and Biotechnology) (TIU-CASD-UBT-S498)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 8th Sem.
Course Title: Career Advancement & Skill Development (IoT and Biotechnology)	Subject Code: TIU-CASD-UBT-S498
Contact Hours/Week: L-T-P: 3-0-0	Credit: 3

Course objective:

1. To enhance the professional, interpersonal, and communication skills of students to meet industry and research expectations.
2. To train students in resume writing, job interview techniques, group discussions, and corporate communication.
3. To build soft skills such as leadership, time management, and problem-solving through interactive sessions.
4. To prepare students for national and international competitive exams, placement drives, and higher education opportunities.

Course Outcomes:

CO Number	Course Outcome (CO)	Knowledge levels
CO1	Write professional emails, reports, SOPs, and deliver formal presentations with clarity and structure.	K3
CO2	Demonstrate effective verbal and non-verbal communication in interviews, group discussions, and interpersonal interactions.	K3
CO3	Develop resumes, CVs, and cover letters tailored to specific job roles or academic programs.	K3

CO4	Apply time management, leadership, and emotional intelligence skills in simulated professional scenarios.	K4
CO5	Evaluate and plan individual career trajectories through goal setting and career mapping exercises.	K4
CO6	Demonstrate awareness of entrepreneurship opportunities and competitive exams for higher education and career advancement.	K2

Course Content

Module	Course Content	Contact Hours
Module 1	Communication Skills: Professional email writing, formal speaking, interpersonal communication, report and SOP writing, presentation skills	15
Module 2	Career Skills: Resume and CV writing, cover letters, facing interviews (HR & Technical), group discussions, mock interviews	15
Module 3	Soft Skills for Professionals: Time management, leadership, emotional intelligence, conflict resolution, adaptability, team building	15
Module 4	Career Readiness: Career mapping, entrepreneurship orientation, competitive exam awareness (GATE, GRE, TOEFL), higher education planning	15
TOTAL HOURS		60 HOURS

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	2	-	-	-	2	3	2	2	-	-	1	2
CO2	-	-	-	-	-	2	-	2	3	3	1	2	-	2	-	2
CO3	-	-	-	-	1	-	-	-	2	3	1	2	-	1	-	1
CO4	1	2	-	2	2	2	-	2	3	2	3	3	1	2	2	3
CO5	1	2	-	-	2	-	-	-	2	2	2	3	-	1	2	3
CO6	-	1	-	-	2	1	1	1	1	2	3	3	-	1	2	3

Comprehensive viva-voce (**TIU-UBT-G402**)

Program: B. Tech. in Biotechnology	Year, Semester: 4th Yr. 8th Sem.
Course Title: Comprehensive viva-voce	Subject Code: TIU-UBT-G402
Contact Hours/Week: L-T-P: 0-0-2	Credit: 1