TECHNO INDIA UNIVERSITY
WEST BENGAL

DEPARTMENT OF BIOTECHNOLOGY

PROGRAM
4-YEARS B.TECH BIOTECHNOLOGY

SYLLABUS

PROGRAM CODE - TIU-UBT

Department of Mathematics

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:	**a**nalyze 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**
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**	**10 Hours**
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**

Books:

1. Higher Engineering Mathematics, *B. S. Grewal*
2. Advanced Engineering Mathematics, *Kreyszig*
3. Engineering Mathematics, *Srimanta Pal*

Department of Chemistry

Program:B.Tech Biotechnology	**Year, Semester:** Ist year., IstSem
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 O_2 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_1CB mechanisms.		
TOTAL LECTURES		44 Hours**

BOOKS:

1. S. Glasstone, Text Book of Physical Chemistry, Macmillan India Limited.
2. S. Pahari, Physical Chemistry, New Central Book Agency.
3. P. W. Atkins, Physical Chemistry, 6th Edition, Oxford Publishers.
4. I. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc.
5. Mark Loudon, Organic Chemistry, 4th Edition, Oxford Publishers.

6. P. C. Jain and Monica Jain, "Engineering Chemistry", DhanpatRai, Publishing Company, 16th Edition, 2017
7. Fundamental concept of Inorganic chemistry, volume 3, 2nd edition, by Asim Kumar Das, CBS publishers and distributors Pvt. Ltd.

Department of Chemistry

Program:B.Tech Biotechnology	**Year, Semester:** Ist year., IstSem
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.	**CO1**
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.	**CO2**
CO-3:	Apply the concept of titration in knowing the concentration of unknown acid	**CO3**
CO-4:	Evaluate the functional groups present in organic molecules by simple reactions.	**CO5**

CO-5:	Understand the basics of analyzing various types of organic compounds and their properties	**C2**
CO-6:	Evaluate the hardness of water by performing the complexometric titration and assess the solubility of different solutes in varied solvents.	**C5**

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+}, 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

BOOKS:

1. Hands on chemistry laboratory manual by Paradis & Jeffrey, McGraw-Hill publication
2. Experiments in physical chemistry by Garland and Crawl, McGraw-Hill publication

Department of Computer Science and Engineering

Program: B. Tech. in Biotechnology	**Year, Semester:** 1st Yr., 1st 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**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.
4. Jones, Robin and Stewart, The Art of C Programming, Narosa Publishing House
5. A Kenneth, C Problem solving and Programming, Prentice Hall International.
6. H.Scheldt, C: The Complete Reference, 4th Edition, McGraw Hill

Department of Computer Science & Engineering

Program: B.Tech. in Biotechnology	**Year, Semester:** 1st Yr, 1st 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**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.

Department of Computer Science & Engineering

Program: B.Tech. in Biotechnology	**Year, Semester:** 1st Yr, 1st 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**

Books:

1. "UNIX and Linux System Administration Handbook" – Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, and Dan Mackin
2. "The Linux Command Line: A Complete Introduction" – William E. Shotts Jr.
3. "Learning the bash Shell"– Cameron Newham.

Department of Mechanical Engineering

Program: B. Tech. Biotechnology	**Year, Semester:** 1st Yr., 1st 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: 6 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.
Module-2	**Fitting Shop: 6 hours** Introduction to fitter's tools, gauges, measuring instruments etc.;Job preparation involving the following operations: measuring and marking, filing, drilling, and tapping.
Module-3	**Sheet metal shop: 3 hours** Introduction, metals used in sheet metal work, hand tools, Sheet metal joints; Soldering.
Module-4	**Welding Shop: 3 hours** Introduction to gas and arc welding; Soldering and brazing etc.; Welding equipment and welding materials.
Module-5	**Machine Shop: 6 hours** 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**

Recommended Books:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, **Elements of Workshop Technology** (Vol. – I & II)
2. H S Bawa. ***Workshop Practice,*** McGraw Hill Education; 2nd edition, 2/e
3. Kannaiah, P. and K.L. Narayana (2009), **Workshop Manual**, Scitech Publishers
4. Begeman, M. L. and Amstead, B. H., **Manufacturing Process**, 8th Ed., 1987, Wiley

Department of English

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**

Books:

1. Sanjay Kumar, Pushp Lata, “Communication Skills”, Oxford University Press, 2015, ISBN: 9780199457069

2. M Ashraf Rizvi, “Effective Technical Communication”, McGraw Hill Education, 2017, ISBN 9352606108

3. Steven A. Beebe, Susan J. Beebe, and Mark V. Redmond, “Interpersonal Communication: Relating to Others”, Pearson, 2013, ISBN-10: 020586273X, ISBN-13: 978-0205862733.

4. Judee K. Burgoon, Laura K. Guerrero, and Kory Floyd, “Nonverbal Communication”, Routledge, 2016, ISBN-10: 1138121348, ISBN-13: 978-1138121346.

5. Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, “Interplay: The Process of Interpersonal Communication”, Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.

6. Joseph A. DeVito, “The Interpersonal Communication Book”, Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.

7. Sarah Trenholm and Arthur Jensen, “Interpersonal Communication”, Oxford University Press, 2013, ISBN-10: 0199827504, ISBN-13: 978-0199827503.

8. John Stewart, “Bridges Not Walls: A Book About Interpersonal Communication”, McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.

9. Pamela J. Kalbfleisch, “Interpersonal Communication: Evolving Interpersonal Relationships”, Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.

10. Mark L. Knapp, John A. Daly, and Frederick P. M. Boster, “Interpersonal Communication Handbook”, Sage Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.

Department of Electrical Engineering

Program: B. Tech. in Biotechnology	**Year, Semester:** 1st Yr., 2nd 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	**5Hours**
KCL and KVL and their applications in purely resistive circuits. Concept of linear, bilateral networks.Sourceconversion, 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-phloads, measurement of 3-ph power.		
MODULE 6:	Semiconductor Devices	**5 Hours**
Energy bands in solids. Intrinsic and extrinsic semiconductors.P-N junctions. Semiconductor diodes: ZenerandVaractor 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 phasetransformer: voltage and current transformation, no-load operation, voltage regulation on resistive load.		
TOTAL LECTURES		**43Hours**

Books:

1. D. Chattopadhyay, P. C. Rakshit, Funndamentals of Electric Circuit Theory, S. Chand. Publications
2. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher

Supplementary Reading:

1. Salivahanan and P. Kumar**,** Circuit Theory, Vikas Publishing House
2. Kulshreshtha, Basic Electrical Engineering: Principles and Application, Tata McGraw-Hill.

Department of Mathematics

Program: B. Tech. in Biotechnology	**Year, Semester:** 1st Year, 2nd 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**

Text books:

1. S. S. Sastry-An Introduction to Numerical Analysis.
2. Dutta and Jana- Numerical Analysis.
3. S. A. Mollah- Numerical Analysis and Computational Procedures
4. Statistics- Murray R. Spiegel & Larry J. Stephens

Textbooks:

1. S. S. Sastry-An Introduction to Numerical Analysis.
2. Dutta and Jana- Numerical Analysis.
3. S. A. Mollah- Numerical Analysis and Computational Procedures
4. Statistics- Murray R. Spiegel & Larry J. Stephens

Department of Physics

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 di electric 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 scaler field , 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= -grad V		
MODULE 2:	**ACCOUSTICS**	**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 B coefficients; 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**

Books:

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited

2. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education private limited

3. Engineering Physics ,DattuprasadRamanlal Joshi, McGraw Hill Education private limited

4. A text book on Basic Engineering Physics, A. Chakrabarti, Chhayaprakashani private Ltd.

5. A text book on Integrated Engg. Physics, A. Chakrabarti, Chhayaprakashani private Ltd.

6. A text book on Applied Engineering Physics, Chhayaprakashani private Ltd.
7. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles,RobertEisberg, Robert Resnick, Wiley
8. Statistical Physics, L.D. Landau, E M.Lifshitz, Butterworth-Heinemann
9. Optics,Ghatak, McGrawHill Education India Private Limited
10. Engineering Physics , Hitendra K Malik & A K Sing, McGraw Hill Education private limited
11. Advanced Acoustics, Dr. D.P. Raychaudhuri, The new bookstall, Revised Ninth Edition, 2009
12. Concepts of Modern Physics (Sixth Edition) by Arthur Beiser (Published by McGraw-Hill).
13. Introduction to Solid State Physics (January2019) by Charles Kittel (Published by Wiley)

Department of Mechanical Engineering

Program:B. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2ND 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****

Books:

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics (Vol.1 & 2), Wiley India 2017.
2. Shames I. H., Rao G. K. M., Engineering Mechanics, Pearson, 2005.
3. Khurmi R.S. ,A Textbook of Engineering Mechanics, S. Chand, 2018.

4. Bhavikatti S. S, Engineering Mechanics, New Age International Publishers, 2021.

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

Program:B.Tech in Biotechnology	**Year, Semester:** 1st Yr., 2nd 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**

Department of Mechanical Engineering

Program: B. Tech. in Biotechnology	**Year, Semester: 1st** Yr., 2nd Sem.
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 (Polygonal, 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****

Books:

Main Reading:

1. Jolhe, Dhananjay A, Engineering Drawing an introduction to AutoCAD, Tata McGraw-Hill.

Supplementary Reading:

N.D. Bhatt, Engineering Drawing, Charotar Publishing House Pvt. Ltd.

Online Content:

1. https://nptel.ac.in/courses/112103019
2. https://nptel.ac.in/courses/112104172

Department of English

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 WORKPLACE DYNAMICS**	**7 Hours**
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**

Books:

1. **Sanjay Kumar, Pushp Lata, "Communication Skills", Oxford University Press, 2015, ISBN: 9780199457069**

2. **M Ashraf Rizvi, "Effective Technical Communication", McGraw Hill Education, 2017, ISBN 9352606108**

3. **Sarah Trenholm and Arthur Jensen, "Interpersonal Communication", Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257**

4. **Claude G. Théoret, "Advanced Communication Skills: 7 Keys to Personal and Professional Growth", Independently Published, 2020, ISBN-10: 1656945618, ISBN-13: 978-1656945615**

5. **Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, "Interplay: The Process of Interpersonal Communication", Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.**

6. **Joseph A. DeVito, "The Interpersonal Communication Book", Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.**

7. **Mark L. Knapp and John A. Daly, "The SAGE Handbook of Interpersonal Communication", SAGE Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.3.**

8. **John Stewart, "Bridges Not Walls: A Book About Interpersonal Communication", McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.**

9. **Pamela J. Kalbfleisch, "Interpersonal Communication: Evolving Interpersonal Relationships", Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.**
10. **Deborah Tannen, "Talking from 9 to 5: Women and Men at Work", William Morrow Paperbacks, 2001, ISBN-10: 0060959622, ISBN-13: 978-0060959623.**

Department of Electrical Engineering

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**
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**

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**

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 (Vth) and resistance (Rth) from a given circuit.

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

Experiment 4	**Characteristic of Fluorescent Lamp**	**3 Hours**

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	**Familiarazation with basic electronics components**	**3 Hours**

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**

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**

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**
Half wave and full wave rectifiers (centre tape and bridge), regulation ripple factor		
TOTAL –45 Hrs		

Department of Physics

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**

Books:

1. Laboratory Manual

2. Advanced Practical Physics (Volume I and II) for BSc Physics Lab, B. Ghosh & K.G Mazumdar

3. An advanced course in practical physics by D . Chattopadhyay and P.C Rakshit, New central agency(P)Ltd.

Department of Computer Science & Engineering

Program: B.Tech. Biotechnology	**Year, Semester:** 1st year , 2nd 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**
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**
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**
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**
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**

Books:

1. "Data Structures in C" by Tanenbaum, Moshe J. &Augenstein, PhilipC
2. Gilberg and Forouzan: “Data Structure- A Pseudocode approach with C” by Thomson publication
3. “Fundamentals of Data Structure” (Schaum's Series) Tata-McGraw-Hill.
4. “Fundamentals of data structure in C” Horowitz, Sahani & Freed, Computer Science Press.
5. "Data Structures Using C" by Reema Thareja

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.

Course Title: Microbiology	**Subject Code: TIU-UBT-T203**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. **Understand microbial diversity** through taxonomy, classification, and modern identification techniques.
2. **Examine microbial structure, growth, metabolism, and genetics** in prokaryotes and eukaryotes.
3. **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 micro-organisms, 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**

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Biochemistry	**Subject Code: TIU-UBT-T205**
Contact Hours/Week: **L-T-P: 3-0-0**	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. **Understand fundamental biochemical principles** including pH, buffers, and thermodynamics.
2. **Explore the structure and function of biomolecules** such as nucleic acids, proteins, carbohydrates, lipids, hormones, and vitamins.
3. **Analyze metabolic pathways** involved in carbohydrate, lipid, amino acid, and nucleotide metabolism.
4. **Examine protein folding, structure-function relationships, and enzymatic mechanisms.**

5. **Assess energy transformations in biochemical reactions**, including Gibbs free energy and oxidative phosphorylation.
6. **Evaluate the biochemical basis of essential physiological processes** like photosynthesis and metabolic regulation.

COURSE OUTCOME:

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

Department of Biotechnology

Program:B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Environmental Biotechnology	**Subject Code: TIU-UBT-T207**
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 setting 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**

Department of Biotechnology

Program:B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Cell Biology	**Subject Code: TIU-UBT-T212**
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**

Department of Biotechnology

Program:B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Molecular Biology	**Subject Code: TIU-UBT-T209**
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, Messelson 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, tRNAidentity, aminoacyltRNAsynthetase, translational proof-reading, translational inhibitors.		
TOTAL LECTURES		**45 Hours**

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Microbiology Laboratory	**Subject Code: TIU-UBT-L203**
Contact Hours/Week: **L-T-P: 0-0-6**	**Credit: 3**

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, assignmnet		
MODULE 5:	**EXPERIMENT : 5**	
Biochemical Characterization of Bacteria: Catalase, Oxidase and Urease Tests.evaluation and presentation		
MODULE	**EXPERIMENT : 6**	

6:		
Antibiotic Assay (Disc Diffusion Method), evaluation and assessment		

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 3rd Sem.
Course Title: Biochemistry Laboratory	**Subject Code: TIU-UBT-L205**
Contact Hours/Week: **L-T-P: 0-0-6**	**Credit: 3**

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, explain the concept of absorption maxima, and relate it to the quantification of biomolecules.	K3
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	

Department of English

Program: Btech Biotechnology	**Year, Semester: 2nd year, 3rdsem**
Course Title: CAREER ADVANCEMENT & SKILL DEVELOPMENT	**Subject Code: TIU-UEN-S297**
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** · **The French alphabet and pronunciation** · **Greetings and introductions** · **Numbers and basic expressions of time**	**6 Hours**
MODULE 2:	**IDENTITY AND PERSONAL INFORMATION** · **Talking about oneself and others** · **Nationalities, professions, and family** · **Using "être" and "avoir" verbs**	**6 Hours**
MODULE 3:	**EVERYDAY INTERACTIONS** · **Asking for and giving personal details** · **Talking about preferences and habits** · **Introduction to regular -ER verbs**	**7 Hours**
MODULE 4:	· **Ordering at a café or restaurant** · **Asking for directions** · **Using "aller" and "faire" verbs**	**6 Hours**
MODULE 5:	**DESCRIBING DAILY LIFE** · **Talking about routines and leisure activities** · **Expressing likes and dislikes** · **Introduction to present tense conjugation**	**5 Hours**
TOTAL LECTURES		**30 Hours**

Books:

***Tech French - French for Science and Technology*, Goyal Publishers, 2011**

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 libraries, synthesizing and labeling DNA/RNA probes, and performing hybridization methods such as Southern, Northern, and Western blotting.	K3
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	K4

	development, enzyme stability (e.g., heat stability), and transgene silencing, understanding the practical applications in biotechnology.	

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-Maxmum-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: 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 hemolyticanemia, myasthenia gravis, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis), hypersensitivity (Type I, II, III, IV), Immune Tolerance.		
TOTAL LECTURES		**45 Hours**

Department of Biotechnology

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, dendrimers, gold/silver nanoparticles) for targeted drug and gene delivery	K3
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 photonoptical detector; 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 DNAhelicases,		

topoisomerases etc. Ion channels as molecular switches.		
MODULE 3:		**18 Hours**
Introduction to Nanomedicine, Application of Nanomedicine; Biosensors; Biodegradeable nanoparticles for drug and gene delivery to cells and tissues: liposome, dendrimer, gold nano particle, silver nano particle. Smart Drugs, DNA based nano devices, Nanorobotics, Nanomedical Diagnosis and treatment. Improved Human Abilities; Chromosome Replacement Therapy.		
TOTAL LECTURES		**45 Hours**

Books:

1. Nanotechnology: Principles and Practices" – Sulabha K. Kulkarni
2. "Introduction to Nanotechnology" – Charles P. Poole Jr. & Frank J. Owens
3. "Nanomedicine: Design and Applications of Magnetic Nanomaterials, Nanosensors, and NanoscaleBiodevices" – Thomas J. Webster
4. "Springer Handbook of Nanotechnology" – Bharat Bhushan
6. "Biomaterials Science: An Introduction to Materials in Medicine" – Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons
7. "An Introduction to Biomaterials" – Jeffrey O. Hollinger
8. "Biomaterials: The Intersection of Biology and Materials Science" – Johnna S. Temenoff&Antonios G. Mikos
9. "Advanced Biomaterials: Fundamentals, Processing, and Applications" – Ashutosh Tiwari & Murugan Ramalingam

Department of Biotechnology

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:

1. Understand the fundamentals of fermentation technology and bioprocess optimization.
2. 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**

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 4th Sem.
Course Title: Genetic Engineering Laboratory	**Subject Code: TIU-UBT-L202**
Contact Hours/Week: **L-T-P: 0-0-6**	**Credit: 3**

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	

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 2nd** Yr. 4th Sem.
Course Title: Immunotechnology Laboratory	**Subject Code: TIU-UBT-L204**
Contact Hours/Week: **L-T-P: 0-0-6**	**Credit: 3**

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 interpret diagnostic findings..	K4
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, assignmnet	
Experiment 5:	Immuno-electrophoresis, presentation	
Experiment 6:	Western Blotting, lab evaluation and assessment	

Department of Biotechnology

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, faceting	
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

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 3rd** Yr. 5th Sem.
Course Title: Enzymology	**Subject Code: TIU-UBT-T303**
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

COURSE CONTENT:

MODULE 1:		**15 Hours**
: Introduction, 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.		
MODULE 2:		**15 Hours**
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 3:		**15 Hours**
Immobilized enzyme catalysis; Effects of external mass transfer resistance, effects of inhibitors, temperature and pH on immobilized enzyme catalysis and deactivation, Various applications of enzymes, creation of chimeric enzyme, enzymes produced by recombinant technology.		
TOTAL LECTURES		**45 Hours**

Department of Biotechnology

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

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		**45 Hours**

LECTURES		

Department of Biotechnology

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: 3-0-0**	**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, extrachromosal 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, Co-relation and Regression, Chi-square, T-test, Goodness of Fit, p-value, ANOVA.		
TOTAL LECTURES		**45 Hours**

Department of Biotechnology

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 contaminnts.		
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**

Department of Biotechnology

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 bioproduct 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**

Department of Biotechnology

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	

Department of Biotechnology

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 extraction from complex mixtures.	K4
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	

Department of Biotechnology

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: 0-0-6**	**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**

Department of Biotechnology

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**

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**

Department of Biotechnology

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**
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**
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**
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**

Department of Biotechnology

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

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, Antisence therapeutics; Enzyme therapy; Hormone therapy; Cytokine therapy; Monoclonal Antibody therapy. An introduction to stem cell therapy and regenerative medicine.		
TOTAL LECTURES		**45 Hours**

Books:

1. Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications by Lela Buckingham and Maribeth Flaws
2. Molecular Diagnostics by Anthony Warford and NadègePresneau
3. Molecular Diagnostics: Part 1: Technical Backgrounds and Quality Aspects by E. van Pelt-Verkuil, W.B. van Leeuwen, and R. te Witt
4. Fundamentals of Molecular Diagnostics by David E. Bruns, Edward R. Ashwood, and Carl A. Burtis

Department of Biotechnology

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

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	

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 3rd** Yr. 6th Sem.
Course Title: Plant Biology Laboratory	**Subject Code: TIU-UBT-L314**

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	

Department of Biotechnology

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: 2-0-0**	**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**

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 7th Sem.
Course Title: Career Advancement & Skill Development (Journal Club)	**Subject Code: TIU-UBT-S401**
Contact Hours/Week: **L-T-P: 0-0-6**	**Credit: 3**

Course objective:

1. To develop analytical and communication skills through structured journal club
2. 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:

CO Number	Course Outcome	Knowledge Level
CO1	Explain literature search techniques and interpret scientific articles using structured analysis frameworks.	**K2**
CO2	Evaluate journal quality using citation metrics and impact factors.	**K4**
CO3	Prepare and deliver structured journal presentations using the IMRaD format.	**K3**
CO4	Demonstrate foundational teaching techniques including microteaching and use of blackboard/digital tools.	**K3**
CO5	Apply pedagogical principles and diverse learning styles in classroom scenarios.	**K4**
CO6	Reflect on peer feedback to improve communication, teaching clarity, and student engagement.	**K4**

Course Content:

Module	Course Content	Contact Hours
Module 1	Journal Club Component: Literature search and selection strategies, Critical reading and analysis, Presentation structure (IMRaD), Peer discussions and feedback, Evaluation of journal metrics and impact factor	**30**
Module 2	Teaching Practicum Component: Basics of pedagogy and learning styles, Blackboard and digital teaching skills,	**30**
Module 3	Peer teaching, microteaching sessions, Constructive feedback and classroom engagement strategies	**30**
TOTAL		**90**

Department of Biotechnology

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 quality and reliability in biotechnological research.	K3
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**

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Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 7th Sem.
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**

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 7th Sem.
Course Title: Project Work/Industrial Training	**Subject Code: TIU-UBT-P499**
Contact Hours/Week: **L-T-P: 0-0-20**	**Credit: 10**

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 - Introduction to research/internship process - Identification of supervisor (academic/industry) - Defining goals, objectives, expected outcomes, and deliverables
Module 2	Execution Phase - 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 - Data analysis and visualization - Troubleshooting and optimization - Interpretation of results - Application of analytical/statistical tools (as applicable)
Module 4	Report Writing and Presentation - Final report/thesis preparation - Presentation to academic panel/industry mentors - Viva voce and feedback collection

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 7th Sem.
Course Title: Training	**Subject Code: TIU-UES-S495**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

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

Department of Biotechnology

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 7th Sem.
Course Title: Project Work/Industrial Training	**Subject Code: TIU-UBT-P496**
Contact Hours/Week: **L-T-P: 0-0-36**	**Credit: 18**

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 audience.	**K3**

Program: B. Tech. in Biotechnology	**Year, Semester: 4th** Yr. 8th Sem.
Course Title: Career Advancement & Skill Development	**Subject Code: TIU-UBT-S402**
Contact Hours/Week: **L-T-P: 0-0-4**	**Credit: 2**

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**