TECHNO INDIA UNIVERSITY

WEST BENGAL

DEPARTMENT OF MICROBIOLOGY

SYLLABUS STRUCTURE AND COURSE DETAILS

w.e.f 2024-25

SEMESTER 1

Department of Microbiology

INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 1st Yr., 1st Sem
Course Title: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (Theory)	**Subject Code:** TIU-UMB-MJ-T11101
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. To understand the historical progression of microbiology as a scientific discipline. analyze the nature of problems solved with machine learning techniques
2. Describe the principles of binomial nomenclature in microbial classification.
3. To examine the general characteristics of acellular microorganisms such as viruses, viroids, and prions.
4. To explore the history of phycology with an emphasis on contributions from Indian scientists.
5. To trace the historical developments in mycology and the contributions of notable mycologists.
6. To understand the general characteristics and diversity of protozoa.
7. To explore the diverse applications of microbiology in research and industry.

COURSE OUTCOME :

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

CO-1:	Remember the Historical Development of Microbiology.	K1
CO-2:	Understand the Microorganisms Using Standard Taxonomic Systems	K2
CO-3:	Describe the General Characteristics of Microbial Groups	K4
CO-4:	Analyze Algae, Fungi, and Protozoa in Detail	K4
CO-5:	Evaluate the Scope and Applications of Microbiology	K5
CO-6:	Apply the research outcomes in everyday research	K3

COURSE CONTENT :

MODULE 1:	**HISTORY OF DEVELOPMENT OF MICROBIOLOGY**	**10 Hours**
Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributionsof Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner		
MODULE 2:	**SYSTEMS OF CLASSIFICATION**	**10 Hours**
Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms		
MODULE 3:	**GENERAL CHARACTERISTICS OF DIFFERENT GROUPS**	**15 Hours**
Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. Algae: History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food. Fungi: Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins. Protozoa: General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia		

MODULE 4:	**OVERVIEW OF SCOPE OF MICROBIOLOGY**	**10 Hours**
Application of microbes in different areas of everyday use and research.		
TOTAL LECTURES		**45 Hours****

Books:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9 Edition. McGraw Hill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005).General Microbiology. 5th edition. McMillan.

INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (Practical)

Program: B. Sc. in Microbiology	**Year, Semester:** 1st Yr., 1st Sem
Course Title: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (Practical)	**Subject Code:** TIU-UMB-MJ-L11101
Contact Hours/Week: 0–0–1 (L–T–P)	**Credit: 1**

COURSE OBJECTIVE :

Enable the student to:

1. Microbiology Good Laboratory Practices and Biosafety
2. Principle and Applications of Important Laboratory Instruments
3. Preparation and Inoculation of Culture Media for Bacterial Cultivation
4. Determination of Microbial Cell Size Using Micrometry

COURSE OUTCOME :

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

CO-1:	Demonstrate Good Laboratory Practices and Biosafety in Microbiology	K2
CO-2:	Operate and Understand the Principles of Microbiological Instruments	K2
CO-3:	Prepare and Inoculate Culture Media for Bacterial Cultivation	K4
CO-4:	Examine Fungal and Algal Specimens Using Microscopic Techniques	K3
CO-5:	Analyze Protozoan Morphology and Identification	K4
CO-6:	Determine the Size of Microbial Cells Using Micrometry and perform Enumeration of Microbes Using Haemocytometry	K3

COURSE CONTENT :

MODULE 1:	**DEVELOPMENT OF MICROBIAL CULTURE AND OBSERVATION**	**15 Hours**
1. Microbiology Good Laboratory Practices and Biosafety. 2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory. 3. Preparation and inoculation of culture media for bacterial cultivation . 4. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts 5. Study of Spirogyra and Chlamydomonas, Volvox using temporary Mounts 6. Study of the following protozoans using permanent mounts/photographs: Amoeba, Entamoeba, Paramecium and Plasmodium 7. Determination of size of microbial cell using micrometry. 8. Enumeration of microbes: Yeast by Haemocytometer		
TOTAL LECTURES		**15 Hours****

CHEMISTRY (Theory)

Program: B.Sc. Chemistry (minor)	**Year, Semester:** Ist year., 1st Sem.
Course Title: Chemistry	**Subject Code**: TIU-UCH-MI-T11101
Contact Hours/Week: 3-0-0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the basic concept of structure of atom, covalent bonding, non covalent bonding thermodynamics, chemical kinetics ionic equilibria, nomenclature, stereochemistry, structures, reactivity, and mechanism of chemical reactions.

2. Apply the concept of thermodynamics, chemical kinetics, and ionic equilibria, in the relevant advanced and emerging field of biotechnological studies.
3. Apply the concept of covalent and non covalent bonding, in acquiring information regarding the metals used in any process of biotechnological system.
4. Remember the knowledge of stereochemistry and reaction mechanism in understanding the glimpse of the reaction pathways involved in the biotechnology process.
5. Understand the concept of various types of bonding, energy distributions in atomic and molecular orbital makes the student easier to understand the technology based on them.

COURSE CONTENT:

MODULE 1:		**14 Hours**
1	**ATOMIC STRUCTURE**	**5 Hours**
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics, de Broglie hypothesis, Heisenberg's uncertainty principle. Schrödinger equation. Hydrogen and hydrogen like systems (detail solution not required). Radial and angular parts of wave function, quantum numbers, shapes of s, p and d orbitals, Extension to multi electronic systems. Aufbau principle and its limitations, Pauli's exclusion principle, and Hund's rules of maximum multiplicity.		
2	**COVALENT BONDING**	**4 Hours**
Lewis structure. VSEPR theory, shape and polarity of simple molecules and ions, Valence Bond Theory, concept of hybridization and shale of molecules. Molecular orbital theory, MO diagram of homonuclear and heteronuclear (CO & NO) diatomic molecules, HOMO, LUMO, Bond order.		
3	**NON COVALENT BONDING**	**5 Hours**
(i) Ionic Bonding: General characteristics of ionic compounds. Ionization energy, electron affinity, lattice energy, Born-Haber cycle. (ii) Metallic Bonding: Theories of bonding in metals. Band theories. (iii) Weak Interactions: Hydrogen bonding and van der Waal's interactions		
MODULE 2:		**15 Hours**
1	**FUNDAMENTALS OF ORGANIC CHEMISTRY**	**4 Hours**

Types of organic reactions, Inductive effect, resonance and hyper conjugation. nucleophiles and electrophiles		
2	**BONDING IN ORGANIC MOLECULES**	**5 Hours**
Concept of hybridization and formation of single, double and triple bonds, Resonance and resonance energy. Qualitative idea about molecular orbital's, bonding and anti bonding molecular orbital's, idea ofσ, σ*, π, π*, nonbonding MOs, concept of HOMO, LUMO and SOMO. Hückel's rules of aromaticity, anti aromaticity and non-aromaticity.		
3	**STEREOCHEMISTRY**	**6 Hours**
Different types of isomerism. Concept of chirality and optical activity (up to two carbon atoms). Inter conversion of Fischer and Newman representations. Enantiomers, diastereomers, and meso compounds. Threo/ erythro, D/ L, cis/ trans, and E/ Z nomenclature. CIP Rules: R/S (only one chiral carbon atoms) nomenclature		
MODULE 3:		**15 Hours**
1	**GASSEOUS STATE**	**3 Hours**
Kinetic theory of gases, ideal gas laws based on kinetic theory. Collision in a gas, mean free path, collision diameter, collision number. Behaviour of real gases, the van der Waal's equation. Critical phenomena, critical constants of a gas and their determination, the van der Waals equation and critical state, Principle of corresponding states		
2	**THERMODYNAMICS**	**6 Hours**
First Law of thermodynamics. State and path functions, sign convention for heat and work, nature of work. Internal energy, enthalpy, heat changes at constant volume and constant pressure, heat capacities (CV, CP) and their relationship for ideal gases. Thermodynamic quantities (w, q, ΔU, ΔH) for isothermal and adiabatic reversible expansion of ideal gases and their comparison. Change in internal energy (ΔU) and enthalpy (ΔH) of chemical reactions, relation between ΔU and ΔH. Concept of entropy, calculation of entropy changes. Gibbs free energy, its measurement and its application in prediction of spontaneity of a process. Variation of heat of reaction with temperature (Kirchhoff's equation).		
3	**CHEMICAL KINETICS**	**6 Hours**
Order and molecularity of chemical reactions. Rate laws for zero, 1st and 2nd order reactions and in general for any nth order reaction. Determination of order of a reaction by half-life and differential methods. Effect of temperature on rate, arrheninus equation. Rate determining step and steady state approximation. Opposing, consecutive and parallel reactions (first order		

steps only). Enzymatic reactions	
TOTAL LECTURES	**44 Hours ****

Note: **Total teaching hours for a 4credit course = 39 – 45 hours with 3 Lecturers and 1 tutorial

BOOKS

1. Basic Inorganic Chemistry, F. A Cotton and G. Wilkinson, John Wiley & Sons.
2. Concise Inorganic Chemistry, J. D. Lee, Chapman & Hall.
3. Organic Chemistry, I. L. Finar, Vol. I & Vol. II, ELBS and Longman Ltd., New Delhi.
4. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall of India (P) Ltd., New Delhi.
5. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press.
6. Physical Chemistry, P. Atkins and J. De Paula, International Student Edition, Oxford University Press.
7. Physical Chemistry, P. C. Rakshit, Sarat Book House, Calcutta.
8. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania**,** Shoban Lal Nagin Chand & Co., Jalandhar.

B.Sc. CHEMISTRY (Minor) Practical

Program: B.Sc. CHEMISTRY (minor)	**Year, Semester:** Ist year., 1st Sem.
Course Title: Chemistry Lab	**Subject Code**: TIU-UCH-MI-L11101
Contact Hours/Week: 0-0-2 (L–T–P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the safety protocol and adhere to the best laboratory practical purpose.
2. Understand the chemical nature of the hazardous chemicals.
3. Understand the basic analytical technique.
4. Apply the basic analytical technique for real time analysis.
5. Analyze the result obtained post performance of the experiment

COURSE OUTCOME:

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

CO-1:	**Understand** the safety protocols, and practice the best practices inside a chemistry lab.	K2
CO-2:	**Understand** the nature of various types of reagents and their handling as well as storage.	K2
CO-3:	**Analyze** the functional groups present in organic molecules by simple reactions	K4
CO-4:	**Understand** the basics of analyzing various types of organic compounds and their properties.	K4
CO-5:	**Understand** the basic analytical techniques, such as preparation 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 titrimetric and volumetric method.	K2
CO-6:	**Apply** the basic analytical techniques, such as preparation solutions of desired strength, standardization of solutions, and analysis of concentration of the species in the real time analysis.	K3

COURSE CONTENT: ----------

EXPERIMENT-1:	Qualitative Analysis (Organic and Inorganic):
(i) Detection of elements (X, N, S) in organic compounds. [X = Cl, Br, I] (ii) Detection of functional groups: COOH, C=O, CHO, Ar—OH, Ar—NH_2, Ar—NO_2, $CONH_2$ (iii) *Qualitative Inorganic Mixture Analysis:* Anions, interfering anions, cations and insolubles.	
EXPERIMENT-2:	Quantitative Analysis (Physical and Volumetric):
i) Standardization of $Na_2S_2O_3$ solution against standard $K_2Cr_2O_7$ solution. (ii) Estimation of available chlorine in bleaching powder. (iii) Determination of reaction rate of iodide with hydrogen peroxide in acidic medium (iodine clock reaction	

BOOK

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

Communicative English- I (TIU-UEN-AEC-S1101)

Program: B.Sc. in MIcrobiology	**Year, Semester: 1st yr, 1st Sem**
Course Title: Communicative English- I	**Subject Code:** TIU-UEN-AEC-S1101
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

The primary objective is to develop in the undergraduate students a level of competence in English required for independent and effective communication for academic and industry needs. In addition to fostering the ability to use English skillfully, the graduates are trained to adapt to the changing social circumstances. These courses also enable them to engage in life-long learning and pursue advanced level studies in future.

COURSE OUTCOME :

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

CO-1:	Remember different principles and usage of grammar.	K1
CO-2:	Understand the use of effective communication, in both spoken and written English.	K2
CO-3:	Comprehend the meaning and nuances of words in the use of vocabulary.	K3
CO-4:	Apply techniques of oral communication in a variety of professional and academic situations.	K4
CO-5:	Create individual expressions in facilitating the dynamics of written communication	K5
CO-6:	Acquire skills required in a professional environment.	K6

COURSE CONTENT :

MODULE 1:	**Fundamentals of Communication**	**5 Hours**
Introduction to communication theory Principles of effective communication Barriers to communication Importance of clarity, precision, and confidence in communication		
MODULE 2:	**Language and Grammar Skills**	**5 Hours**
Basic grammar concepts (tenses, subject-verb agreement, articles, etc.) Sentence structure and formation Common errors in English grammar Pronunciation drills and consonant sounds		
MODULE 3:	**Vocabulary Building & Sentence Formation**	**5 Hours**

Techniques for vocabulary development Word meaning, synonyms, and antonyms Idioms, phrases, and their usage Constructing meaningful and coherent sentences		
MODULE 4:	**Oral Communication & Speaking Skills**	**5 Hours**
Conversational skills for professional and academic settings Pronunciation improvement and articulation Public speaking and presentations Group discussions and interpersonal communication		
MODULE 5:	**Writing Skills & The Writing Process**	**5 Hours**
Writing a well-structured paragraph Linking paragraphs for coherence Writing process: brainstorming, drafting, revising, and editing Writing different types of reports		
MODULE 6:	**Formal Writing & Workplace Communication**	**5 Hours**
Drafting professional documents: Minutes of meetings, agenda, notices, circulars, memos Writing job applications and resumes Report writing for business and academics Email etiquette		
TOTAL LECTURES		**30 HOURS**

Recommended Books:

Main Reading:

1. Lata, Pushp, *Communication Skills*, Oxford University Press, 2015.
2. Rizvi Ashraf, *Effective Technical Communication*, Tata McGraw-Hill, 2017
3. Wren & Martin, *High School Grammar & Composition*, S. Chand and Sons, 1998.

Supplementary Reading:

1. Viswamohan Aysha,*English for Technical Communication*, Tata McGraw-Hill.
2. Gregory Bassham, William Irwin, Henry Nardone & James M. Wallace. *Critical Thinking: A Student's Introduction,* Tata McGraw Hill.
3. CIEFL, Hyderabad, *Exercises in Spoken English*. Parts.I-III.. Oxford University Press

ENVIRONMENTAL SCIENCE (TIU-UOG-CVA-T1101)

Program: B.Sc. in Microbiology	**Year, Semester: 1st yr, 1st Sem**
Course Title: ENVIRONMENTAL SCIENCE	**Subject Code:** TIU-UOG-CVA-T1101
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit: 2**

OURSE OBJECTIVE :

2. Analyze Environmental Components and Their Interactions
3. Evaluate Ecological and Biodiversity Conservation Strategies
4. Assess Pollution, Natural Resources, and Their Management
5. Apply Environmental Policies and Disaster Management Principles

COURSE OUTCOME :

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

CO-1:	Understand Environmental Components and Issues	K2
CO-2:	Analyze Ecosystem Dynamics and Biodiversity Conservation	K4
CO-3:	Evaluate Environmental Chemistry and Water Quality Parameters	K5
CO-4:	Assess the Impact of Meteorological and Natural Resource Changes	K3
CO-5:	Develop Pollution Control and Waste Management Strategies	K6
CO-6:	Remember Environmental Laws, Disaster Management, and Global Agreements	K1

COURSE CONTENT :

MODULE 1:	**FUNDAMENTALS OF ENVIRONMENTAL SCIENCE**	**4 Hours**
Definition, Scope and Importance; Types and Components of Environment (Atmosphere,		

MODULE 2:	ECOLOGY AND BIODIVERSITY	4 Hours
Concept of ecology: Autecology and Synecology – basic ideas, definition; food chains, food webs and trophic levels; Basic Concept of an ecosystem; different types of ecosystem, Ecological pyramids; Definition of biodiversity, Hot-spots of biodiversity; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, etc.; Conservation of biodiversity: in-situ and ex-situ conservation		
MODULE 3:	**CHEMISTRY OF ENVIRONMENT**	**4 Hours**
Fundamentals of water quality; Concept of DO, BOD, COD, Hardness, Alkalinity; Chemistry of Heavy Metals-Pb, Hg, Cd and As - Physical and chemical properties; Behavior of heavy metals and their compounds in environment.		
MODULE 4:	**METEOROLOGY**	**5 Hours**
Basic knowledge of climatological parameters for environmental study; Weather and climate; Western disturbance, Tropical cyclones, Monsoon, El-Nino and La-Nina phenomena.		
MODULE 5:	**NATURAL RESOURCES**	**5 Hours**
Concept of Renewable and Non-renewable resources; Land degradation, soil erosion and desertification; Deforestation: Causes, consequences and remedial measures; Water: Use and overexploitation of surface and ground water, floods, droughts; Energy resources: Environmental impacts of energy generation use of alternative and non-conventional energy sources, growing energy needs.		
MODULE 6:	**ENVIRONMENTAL POLLUTION**	**4 Hours**
Environmental pollution: concepts and types; Air, water, soil, noise and marine pollution-causes, effects and controls; Temperature inversion; photochemical Smog; Green House Gas (GHG) emissions reduction;Concept of hazards waste and human health risks; Solid waste management: Control measures of Municipal, biomedical and e-waste; Rainwater		

Harvesting; Green Technology		
MODULE 7:	**NATURAL HAZARDS AND DISASTER MANAGEMENT**	**5 Hours**
Definition of hazard and disaster; Natural, technological and context hazards; Natural hazards - earthquake; volcanoes - cause and effects; floods: types and nature, effects; landslides: causes and types of landslides, effects; drought: types of drought - meteorological, agricultural, hydrological and effects; tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis, effects and impacts of anthropogenic activities.		
MODULE 8:	**ENVIRONMENTAL LAWS AND POLICY, ENVIRONMENTAL AUDIT AND EIA**	**4 Hours**
Climate change, global warming, ozone layer depletion, acid rain and their impacts on human communities and agriculture; Environment Laws: Wildlife Protection Act; Forest Conservation Act; Water (Prevention and control of Pollution) Act; Air (Prevention & Control of Pollution) Act; Environment Protection Act; Biodiversity Act; International agreements: Montreal Protocol, Kyoto protocol and climate negotiations; Convention on Biological Diversity (CBD); Definitions, introduction concepts and types ;scope and methodologiesofEIA,EIAregulationsin Indi a; Environmental summits (Year only); Environmental Audit.		
TOTAL LECTURES		**30 HOURS**

BIOFERTILIZERS AND BIOPESTICIDES (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 1st Yr., 1st Sem
Course Title: BIOFERTILIZERS AND BIOPESTICIDES (Theory)	**Subject Code:** TIU-UMB-SEC-T1101
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. To understand the concept, types, and significance of biofertilizers in sustainable agriculture.
2. Study the isolation, characteristics, and application of Rhizobium in leguminous plants.
3. Analyze the role of free-living nitrogen fixers such as Azospirillum and Azotobacter in soil fertility.

4. To understand the field application and agricultural benefits of phosphate-solubilizing biofertilizers.
5. To study microbe-based bioinsecticides and their advantages over synthetic pesticides.

COURSE OUTCOME :

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

CO-1:	Understand the Historical Development of Microbiology.	K2
CO-2:	Classify Microorganisms Using Standard Taxonomic Systems	K1
CO-3:	Describe the General Characteristics of Microbial Groups	K4
CO-4:	Analyze Algae, Fungi, and Protozoa in Detail	K4
CO-5:	Explore the Scope and Applications of Microbiology	K5
CO-6:	Study of research outcomes in everyday research	K2

COURSE CONTENT :

MODULE 1:	**BASICS OF BIOFERTILIZERS**	**10 Hours**
Understanding the concept of biofertilizers, their types, and their role in enhancing soil fertility and plant nutrition. Various production methods for biofertilizers, including composting, vermicomposting, and the use of microbial cultures. General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.		
MODULE 2:	**SYMBIOTIC N2 FIXERS**	**6 Hours**
Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants, Frankia- Isolation, characteristics, Alder, Casuarina plants, nonleguminous crop symbiosis, Azolla - Isolation, characterization, mass multiplication, role in rice cultivation, crop response, field application.		

MODULE 3:	**NON-SYMBIOTIC NITROGEN FIXERS**	**7 Hours**
Free living Azospirillum, Azotobacter - isolation, characteristics, inoculum production and field application.		
MODULE 4:	**PHOSPHATE SOLUBILIZERS**	**7 Hours**
Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application		
MODULE 5:	**MYCORRHIZAL BIOFERTILIZERS**	**8 Hours**
Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhiza and VAM.		
MODULE 6:	**BASICS OF BIOPESTICIDES**	**7 Hours**
Introduction to biopesticides, their classification, and various sources and modes of action of biopesticides.		
MODULE 7:	**BIOINSECTICIDES DERIVED FROM MICROBES**	**10 Hours**
Types of microbe-based bioinsecticides, their advantages over synthetic pesticides (target specificity, environmental safety, integrated pest management); Bacillus thuringiensis: toxin production and field applications, Nucleopolyhedroviruses (NPVs) – application and use		
TOTAL LECTURES		**45 Hours****

Books:

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH Publishing Co. Pvt. Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

Computer Fundamentals and Programming in Python (TIU-UCA-MD-T1103)

Program: B. Sc. in Microbiology	**Year, Semester:** 1st Yr., 1stSem.
Course Title:Computer Fundamentals and Programming in Python	**Subject Code:**TIU-UCA-MD-T1103
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. To introduce the fundamental concepts of computer science and programming using Python, specifically tailored for microbiology applications.
2. To enable students to develop computational thinking and problem-solving skills.
3. To demonstrate the use of Python for data analysis, visualization, and automation in microbiological research.
4. To foster the ability to write, debug, and execute Python programs.

COURSE OUTCOME :

The student will be able to:

CO-1	Remembering: Recall basic concepts of computer science and Python syntax	K1
CO-2	Understanding: Explain the role of programming in solving microbiological data problems.	K2
CO-3	Applying: Utilize Python to perform basic data manipulations and analysis.	K3
CO-4	Analyzing: Break down microbiological data into components for computational processing	K4
CO-5	Evaluating: Assess data outputs and troubleshoot program errors effectively.	K4
CO-6	Creating: Develop Python scripts to automate microbiological data processing.	K6

COURSE CONTENT :

MODULE 1:	**Introduction to Computers**	**3 Hours**
Basics of computer systems, hardware, and software, Operating systems and file management, Application of computers in microbiology.		
MODULE 2:	**Introduction to Python Programming**	**3 Hours**
Installation of Python and IDEs (like Anaconda), Writing and executing basic Python scripts, Understanding variables, data types, and operators.		
MODULE 3:	**Control Structures and Loops**	**3 Hours**
Conditional statements (if, elsif, else), Looping structures (for, while), Applications in microbiological data processing.		
MODULE 4:	**Functions and Modules**	**3 Hours**
Creating user-defined functions, Importing and using standard Python libraries, Writing modular code for data analysis.		
MODULE 5:	**Data Structures in Python**	**3 Hours**
Lists, tuples, sets, and dictionaries, Storing and manipulating microbiological data, Practical applications in data storage.		
MODULE 6:	**File Handling and Data I/O**	**3 Hours**
Reading from and writing to files, Handling CSV and text data, Data logging for experimental results		
MODULE 7:	**Introduction to Numpy and Pandas**	**3 Hours**
Using Numpy for numerical operations, Pandas for data manipulation and analysis, Working with large microbiological datasets.		

MODULE 8:	**Data Visualization**	**3 Hours**
Introduction to Matplotlib and Seaborn, Plotting graphs and histograms, Visual representation of experimental data.		
MODULE 9:	**Bioinformatics Data Handling**	**3 Hours**
Parsing DNA/RNA sequence data, Basic data transformation and analysis, Case studies on microbiological datasets.		
MODULE 10:	**Project and Assessment**	**3 Hours**
Group projects: Automating data analysis, Presentation of solutions, Feedback and course evaluation.		
TOTAL LECTURE		30 Hours

Recommended Books:

1. "Python Programming: A Modern Approach" by Vamsi Kurama
2. "Introduction to Computing and Problem Solving with Python" by Jeeva Jose
3. "Python for Bioinformatics" by Sebastian Bass