



TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Curriculum for 2-year M.Sc in Microbiology

Department of Microbiology

Techno India University, West Bengal

EM-4, EM Block, Sector V, Bidhannagar,

Kolkata, West Bengal 700091

Course Curriculum For All Semester

SEMESTER 2

Department of Microbiology, Basic of Pathology (Theory)

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Basic of Pathology (Theory)	Subject Code: TIU-PMB-T112
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand Human and Plant-Microbe Interactions
2. Analyze Antibacterial Agents and Drug Resistance
3. Apply Hematological Techniques in Laboratory Practice

COURSE OUTCOME :

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

CO-1:	Describe the normal flora of the human body	K1
CO-2:	Classify bacterial toxins and their mechanisms	K2
CO-3:	Evaluate methods of bacterial control and drug resistance	K5
CO-4:	Analyze plant responses to biotic and abiotic stress	K4
CO-5:	Demonstrate hematology techniques in clinical settings	K3
CO-6:	Explain blood circulation and immune mechanisms	K2

COURSE CONTENT :

MODULE 1:	Flora of human body	9 Hours
Normal flora of human body, Bacterial toxins, toxicity and pathogenesis		
MODULE 2:	Antibacterial substances	9 Hours

Antibacterial substances and drug resistance: Control of bacterial growth - physical and chemical agents, preservation methods, stress responses		
MODULE 3:	Host-parasite relationship	9 Hours
Host-parasite relationship: Host range of pathogens, Koch's postulate and phenomenon; normal flora, parasitism and pathogenicity, routes of infection, virulence factor and chemical mediators, toxicity and pathogenesis		
MODULE 4:	Plant pathology	9 Hours
Plant pathology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses		
MODULE 5:	Hematology	9 Hours
Basic hematology, laboratory organization and safety measures and waste management. Anticoagulants, sample collection techniques, preservation, transport and handling		
MODULE 6:	Blood and circulation	9 Hours
Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	1	3	2	–
CO2	3	3	2	–	–	–	–	2	3	3	2
CO3	3	3	2	2	–	–	2	2	3	3	3

CO4	3	2	2	2	–	–	2	2	3	3	3
CO5	3	2	–	2	–	–	–	2	3	2	2
CO6	3	2	–	2	–	–	–	2	3	2	2

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘ - ’ Not applicable

Books:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications, 1999.
4. Fundamental of Immunology, 4th edition, Lippencott Raven, 1999

Department of Microbiology, Environment and Food Microbiology (Theory)

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Environment and Food Microbiology (Theory)	Subject Code: TIU-PMB-T114
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand Ecological Interactions and Ecosystem Dynamics
2. Analyze Biodiversity and Conservation Strategies
3. Apply Microbiological Principles in Food Safety and Fermentation

COURSE OUTCOME :

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

CO-1:	Describe ecological and environmental factors	K1
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CO-2:	Classify ecosystem components and energy flow	K4
CO-3:	Assess biodiversity conservation approaches	K5
CO-4:	Explain food spoilage and preservation methods	K2
CO-5:	Demonstrate microbial roles in food fermentation	K3
CO-6:	Analyze foodborne pathogens and diseases	K4

COURSE CONTENT :

MODULE 1:	Environmental complex	5 Hours
Environmental complex, interaction of ecological factors: light, temperature, precipitation (rainfall), humidity of air, atmospheric gases and wind; topographical factors; edaphic factors		
MODULE 2:	Ecosystem	5 Hours
Ecosystem management. Concept of ecosystem and ecosystem management, trophic structure of the ecosystem; ecotones and edges; ecosystem diversity; classification of ecosystems; stability of ecosystem; examples of ecosystem: A pond; agroecosystem. Energy flow through ecosystem, energy environment		
MODULE 3:	Productivity	5 Hours
Concept of productivity; energy partitioning in food chain and food webs		
MODULE 4:	Population	5 Hours
Population properties, density dependent and density independent mechanism of population regulation. Concept of habitat and niche, r and k selection		
MODULE 5:	Biodiversity	5 Hours
Types of interactions between two species; co-evolution. Biodiversity		
MODULE 6:	Conservation	5 Hours
Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy.		

MODULE 7:	Spoilage and Preservation of food	5 Hours
Microorganisms associated with food (milk, meat, fish, cereals, vegetables and fruits). Spoilage of foods, maintenance of food sterility and preservatives. Food preservation methods: physical, synthetic, natural and biological.		
MODULE 8:	Food processing	5 Hours
Microbial food processing: role of indicating microorganisms like lactic acid and other bacteria yeast and molds. Starter cultures. Lactic acid, bacterocins and other metabolites, their applications		
MODULE 9:	Fermented food	Hours
Fermented food: Production and beneficial effects. Food deterioration by mycotoxins. Characteristics of food borne diseases caused by Clostridium, E. coli, Listeria, Salmonella, Shigella		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	3	2	3	2	-
CO2	3	2	-	-	-	-	3	2	3	2	-
CO3	3	3	2	2	-	-	3	2	3	3	2
CO4	3	2	-	2	-	-	-	2	3	2	2
CO5	3	2	2	2	-	-	2	2	3	2	3
CO6	3	3	-	2	-	-	2	2	3	3	2

'3' – Strongly correlated; '2' – Moderately correlated; '1' – Slightly correlated; '- ' Not applicable

Books:

1. Microbiology: Michael Pelczar, E.C.S Chan, Noel R. Krieg; Tata McGraw - Hill Education (2001); 5th Edition.
2. General Microbiology: Author: Hans Gunter-schlegel, Schlegel Hans Gunter, Hans Gunter
3. Schlegel; Cambridge University Press (1993); 7th Revised Edition Topley and Wilson's Principles of Bacteriology; Virology; and Immunity Graham Wilson.

Department of Microbiology, Biological evolution (Theory)

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Biological evolution (Theory)	Subject Code: TIU-PMB-T122
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the Foundations of Evolutionary Theory
2. Explore the Molecular and Genetic Basis of Evolution
3. Apply Evolutionary Concepts to Biodiversity and Adaptation

COURSE OUTCOME :

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

CO-1:	Explain major evolutionary theories	K1
CO-2:	Analyze the origin of life and unicellular evolution	K4
CO-3:	Describe the evolutionary timeline and fossil record	K1
CO-4:	Apply molecular evolution concepts	K3
CO-5:	Evaluate mechanisms of evolutionary change	K5

CO-6:	Investigate patterns of adaptation and co-evolution	K6
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COURSE CONTENT :

MODULE 1:	Introduction	7 Hours
Emergence of evolutionary thoughts		
MODULE 2:	Theory	7 Hours
Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis		
MODULE 3:	Origin of cells	7 Hours
Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism		
MODULE 4:	Evolutionary History	8 Hours
Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.		
MODULE 5:	Molecular Evolution	8 Hours
Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence		
MODULE 6:	Mechanisms	8 Hours
The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
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CO1	3	2	–	–	1	–	–	–	3	2	–
CO2	3	3	–	–	–	–	–	–	3	2	2
CO3	3	2	–	–	1	–	–	–	2	2	–
CO4	3	3	2	3	–	–	–	2	3	3	3
CO5	3	3	2	3	–	–	–	2	3	3	2
CO6	3	3	2	2	–	–	2	2	3	3	3

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘-’ Not applicable

Books:

4. Microbiology: Michael Pelczar, E.C.S Chan, Noel R. Krieg; Tata McGraw - Hill Education (2001); 5th Edition.
5. General Microbiology: Author: Hans Gunter-schlegel, Schlegel Hans Gunter, Hans Gunter
6. Schlegel; Cambridge University Press (1993); 7th Revised Edition Topley and Wilson's Principles of Bacteriology; Virology; and Immunity Graham Wilson.

Department of Microbiology, Pharmacology and Bioethics (Theory)

Program: M. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Pharmacology and Bioethics (Theory)	Subject Code: TIU-PMB-T118
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. To provide foundational knowledge of pharmacology and microbial metabolism
2. To familiarize students with key principles of industrial microbiology
3. To develop competency in quality assurance and control

COURSE OUTCOME :

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

CO-1:	Explain the basic principles of pharmacology and microbial metabolism, including the roles of various microbial nutritional types in drug and energy production.	K1
CO-2:	Analyze microbial fermentation processes for the production of primary and secondary metabolites relevant to the pharmaceutical and food industries	K3
CO-3:	Evaluate ethical issues, regulatory policies, and biosensor applications related to microbiological research and pharmaceutical development.	K3
CO-4:	Apply knowledge of Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in ensuring quality and safety in microbiological and pharmaceutical settings	K3
CO-5:	Design sterile product manufacturing units and microbiology laboratories with a focus on food safety, contamination control, and hazard prevention.	K5
CO-6:	Assess microbiological quality standards, quality assurance/control systems, and the importance of intellectual property rights and bioethics in the life sciences industry.	K6

COURSE CONTENT :

MODULE 1:	Basic of pharmacology	7 Hours
Basic of pharmacology, Pharmacology related microbial product and drug metabolism. Microbial Metabolism: Different microbes according to nutritional pattern, chemolithotrophs, chemoorganotrophs, phototrophs, Nitrogen and sulphur metabolism		
MODULE 2:	Microbial fermentation	8 Hours
Microbial fermentation and production of small and macro molecules		
MODULE 3:	Ethics	7 Hours

Animal & human ethics involved in microbiological work Regulatory practices, biosensors and applications in Pharmaceuticals: financing R&D capital and market outlook. IP, BP, USP. Government regulatory practices and policies, FDA perspective. Reimbursement of drugs and biologicals, legislative perspective. Rational drug design. Immobilization procedures for pharmaceutical applications (liposomes).		
MODULE 4:	Quality Assurance	7 Hours
Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry		
MODULE 5:	Food safety	8 Hours
Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory) Safety in microbiology laboratory. Current and future implications concerning food safety, hazards and risks.		
MODULE 6:	Quality assurance	8 Hours
Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISO, FSSAI, ISI, CIP, Bureau Of Indian Standards (BIS) etc		
MODULE 7:	QA and QC	5 Hours
QA and QC in manufacturing and in process of concern companies. Concept of Intellectual Property Right and patent formulation. Bioethics		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	–	2	–	–	–	–	3	2	1
CO2	3	3	2	2	–	–	–	2	3	2	2
CO3	3	3	3	3	–	–	–	2	3	3	3
CO4	3	3	3	3	–	–	–	2	3	3	3
CO5	3	3	3	3	–	–	–	2	3	3	3
CO6	3	2	3	3	–	–	–	2	3	3	3

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Books:

1. Microbiology: Michael Pelczar, E.C.S Chan, Noel R. Krieg; Tata McGraw - Hill Education (2001); 5th Edition.
2. General Microbiology: Author: Hans Gunter-schlegel, Schlegel Hans Gunter, Hans Gunter
3. Biotechnology & Patent Law: N. S. Sreenivasulu; C. B. Raju Manupatra (2008);1st Edition.

Fundamentals of entrepreneurship by sangramkesharimohanty

Department of Microbiology, Biostatistics and Bioinformatics (Theory)

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Biostatistics and Bioinformatics (Theory)	Subject Code: TIU-PMB-T120
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

4. Understand Statistical and Bioinformatics Principles
5. Develop Data Analysis and Computational Skills
6. Analyze Gene Regulatory and Computational Models

COURSE OUTCOME :

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

CO-1:	Explain measures of central tendency and probability distributions	K1
CO-2:	Perform hypothesis testing and statistical analysis	K3
CO-3:	Interpret bioinformatics algorithms for sequence analysis	K3

CO-4:	Apply molecular phylogeny techniques	K3
CO-5:	Evaluate gene regulatory networks and computational models	K5
CO-6:	Develop skills in ligand-protein interaction studies	K6

COURSE CONTENT :

MODULE 1:	Measures of central tendency	7 Hours
Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal)		
MODULE 2:	Sampling	8 Hours
Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X ² test		
MODULE 3:	Statistics	7 Hours
Basic introduction to Multivariate statistics, etc		
MODULE 4:	Bioinformatics	7 Hours
Biological sequence database. Sequence comparison, pairwise alignment, multiple alignment		
MODULE 5:	Database	8 Hours
Mutation matrix and its application. Database searching, algorithms of FASTA and BLAST		
MODULE 6:	Molecular phylogeny	8 Hours

Basic molecular phylogeny. Ligand protein interaction		
MODULE 7:	Gene regulatory networks	5 Hours
Gene regulatory networks : Dynamic nature of <i>E. coli</i> genome, Transcriptional network in <i>S. cerevisiae</i> , Mathematical modeling and computer simulation		
TOTAL LECTURES		45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	–	2	–	–	–	–	3	2	1
CO2	3	3	2	2	–	–	–	2	3	2	2
CO3	3	3	3	3	–	–	–	2	3	3	3
CO4	3	3	3	3	–	–	–	2	3	3	3
CO5	3	3	3	3	–	–	–	2	3	3	3
CO6	3	2	3	3	–	–	–	2	3	3	3

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘-’ Not applicable

Books:

1. Basotia, G.R. and K.K. Sharma. Research Methodology. Chaudhary, C.H. Research Methodology. RBSA Publications. Daniell, W. Elements of Biostatistics in Health Sciences.
2. Singh, S et al. Statistical Methods for Research. Ludhiana: Central Publishing. Enhance, D.N. Fundamentals of Statistics.
3. Gupta, S.P. Statistical Methods. New Delhi: S. Chand.
4. Khan and Khanna. Fundamentals of Biostatistics. Ukaz Publication Zerold and Jar. Biostatistical Analysis.
5. Bioinformatics: Sequence and Genome Analysis, Second Edition (2004) D. Mount, Cold Spring Harbor Laboratory Press, New York

**Department of Microbiology, Career Advancement Skill Development
(CASD)**

Program: M. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Career Advancement Skill Development (CASD)	Subject Code: TIU-PMB-S100
Contact Hours/Week: 2-1-0 (L-T-P)	Credit: 3

COURSE OBJECTIVE :

Enable the student to:

1. Develop Effective Communication Skills
2. Enhance Linguistic Proficiency
3. Improve Professional and Academic Writing

COURSE OUTCOME :

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

CO-1:	Explain fundamental concepts of communication	K1
CO-2:	Analyze the role of language in communication	K4
CO-3:	Use appropriate language in different contexts	K3
CO-4:	Demonstrate proficiency in professional writing	K6
CO-5:	Evaluate different writing styles	K5
CO-6:	Enhance clarity and coherence in writing	K3

COURSE CONTENT :

MODULE 1:	Concepts	17 Hours
<p>Concepts in Communication: Communication as sharing; context of communication; the speaker/writer and the listener/reader; medium of communication; barriers to communication; accuracy, brevity, clarity and appropriateness in communication; Non-verbal skills, Paralanguage and Body language</p>		
MODULE 2:	Semantics	14 Hours

Semantics: A selected list of Synonyms, Antonyms, Homophones and Homonyms. Form and function of words. Syntax: Sentence structures, Verb patterns and their usage	
MODULE 3: Writing Skills	14 Hours
Writing Skills: Types of writing (Expository, Descriptive, Analytic, Argumentative, Narrative etc) and their main features. Resumes and CV's and Cover letters. Memos and Notices. Basics of Formal Reports	
TOTAL LECTURES	45 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	-	-	3	-	-	-	1	2	2
CO2	2	2	-	-	3	-	-	-	1	2	2
CO3	-	1	-	-	3	-	-	-	-	2	2
CO4	-	-	-	-	3	-	-	-	-	2	2
CO5	-	2	-	-	3	-	-	-	-	2	2
CO6	-	2	-	-	3	-	-	-	-	2	2

'3' – Strongly correlated; '2' – Moderately correlated; '1' – Slightly correlated; ' - ' Not applicable

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Pathology Lab	Subject Code: TIU-PMB-L112
Contact Hours/Week: 0-0-2 (L-T-P)	Credit: 1

COURSE OBJECTIVE :

Enable the student to:

1. Understand Antimicrobial Susceptibility Testing
2. Develop Skills in Microbial Interaction and Biofilm Studies
3. Analyze the Kinetics of Bacterial Death and Antimicrobial Action

COURSE OUTCOME :

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

CO-1:	Explain the principles of antimicrobial testing	K1
CO-2:	Perform MIC and MBC determination assays	K3
CO-3:	Evaluate bacterial death kinetics	K4
CO-4:	Conduct disk diffusion and cross-streak antagonism assays	K3
CO-5:	Investigate biofilm formation mechanisms	K5
CO-6:	Develop strategies for biofilm inhibition	K6

COURSE CONTENT :

MODULE 1:	Study of microbial pathogenicity	30 Hours
<ol style="list-style-type: none"> 1. Determination of MIC 2. Determination of MBC and tolerance of an antibacterial agent 3. Death kinetic assay 4. Disk diffusion assay 5. Antagonistic activity of bacteria against fungi by Cross streak method 6. Biofilm formation 7. Biofilm inhibition by antibiofilm agent 		
TOTAL LECTURES		30 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	–	2	–	–	–	1	3	2	2
CO2	3	3	–	2	–	–	–	2	3	2	3
CO3	3	3	2	2	–	–	–	2	3	2	3
CO4	3	2	3	2	–	–	–	2	3	2	3
CO5	3	3	3	3	–	–	–	2	3	3	3
CO6	3	3	3	3	–	–	2	2	3	3	3

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘-’ – Not applicable

Department of Microbiology, Environmental and Food Microbiology Lab

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Environmental and Food Microbiology Lab	Subject Code: TIU-PMB-L114
Contact Hours/Week: 0-0-2 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Develop Practical Skills in Microbial Analysis
2. Analyze Environmental and Agricultural Microbiology
3. Evaluate Microbial Contributions to Food and Health

COURSE OUTCOME :

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

CO-1:	Explain water quality assessment techniques	K1
CO-2:	Perform soil microbial isolation and characterization	K3
CO-3:	Demonstrate microbial-based composting technique	K3

CO-4:	Analyze probiotic characteristics of lactic acid bacteria	K3
CO-5:	Assess microbial enzyme activity in dairy products	K5
CO-6:	Apply microbial techniques in food preservation	K6

COURSE CONTENT :

MODULE 1:	Study of microbial characteristics	30 Hours
<ol style="list-style-type: none"> 1. Testing of water sample to determine microbial load in the different places of urban/rural locality. Enumeration of coliform bacteria (total and fecal) of water through multiple tube fermentation technique (MPN). 2. Determination of Biochemical Oxygen Demand(BOD) 3. Identification of enteric bacilli by IMViC Test 4. Isolation of Phosphate solubilising bacteria from soil. 5. Isolation of free living Nitrogen fixing bacteria from soil 6. Production of vermicompost. Enumeration of microbes and level of N, P, & K before and after composting 7. Production and estimation of IAA from microorganism 8. Methylene Blue reductase test 9. Determination of phosphatase activity of milk. 10. Isolation of Lactic acid bacteria(LAB) from milk 11. Determination of probiotic activity of LAB: pH tolerance, aggregation, autoaggregation, coaggregation and hydrophobicity 12. Preservation of food by using preservative sodium benzoate 		
TOTAL LECTURES		30 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	–	2	–	–	2	1	3	2	2
CO2	3	3	–	2	–	–	1	2	3	3	2
CO3	3	2	2	2	–	–	2	2	3	3	2
CO4	3	3	2	2	–	–	1	2	3	3	3
CO5	3	3	2	2	–	–	1	2	3	3	3
CO6	3	2	3	2	–	–	3	2	3	3	3

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘ - ’ Not applicable

Department of Microbiology, Entrepreneurship Skill Development (ESD)

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
Course Title: Entrepreneurship Skill Development (ESD)	Subject Code: TIU-PES-S198
Contact Hours/Week: 0-0-2 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Understand Entrepreneurial Concepts
2. Enhance Business Planning and Management Skills
3. Develop Innovation and Problem-Solving Abilities

COURSE OUTCOME :

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

CO-1:	Explain key entrepreneurial concepts	K1
CO-2:	Identify and evaluate business opportunities	K4
CO-3:	Demonstrate business planning skills	K3
CO-4:	Assess financial and resource management strategies	K5
CO-5:	Develop innovative solutions to entrepreneurial challenges	K6

CO-6:	Apply leadership and decision-making skills	K3
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COURSE CONTENT :

MODULE 1:	Entrepreneurship Skills	30 Hours
Development of Entrepreneurship Skills		
TOTAL LECTURES		30 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	–	2	2	–	1	2	2	2
CO2	2	3	2	2	2	2	1	2	2	3	3
CO3	2	3	3	2	2	3	–	2	2	3	3
CO4	2	2	3	2	2	2	1	3	2	2	2
CO5	2	2	3	3	2	2	2	3	2	3	3
CO6	2	2	3	2	3	3	2	3	2	3	3

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘ - ’ Not applicable

Department of Microbiology, Training and Seminar Presentation

Program: B. Sc. in Microbiology	Year, Semester: 1 st Yr., 2 nd Sem
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Course Title: Training and Seminar Presentation)	Subject Code: TIU-PMB-S122
Contact Hours/Week: 0-0-2 (L-T-P)	Credit: 2

COURSE OBJECTIVE :

Enable the student to:

1. Enhance Presentation and Communication Skills
2. Strengthen Research and Analytical Thinking
3. Develop Professional and Collaborative Competencies

COURSE OUTCOME :

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

CO-1:	Explain key concepts in scientific communication	K2
CO-2:	Demonstrate proficiency in seminar presentation	K3
CO-3:	Analyze and critique research findings	K4
CO-4:	Develop well-structured reports and presentations	K6
CO-5:	Apply public speaking and interpersonal skills	K3
CO-6:	Assess the impact of audience interaction and feedback	K5

COURSE CONTENT :

MODULE 1:	Working skills Skills	30 Hours
Development of working skills		
TOTAL LECTURES		30 Hours**

CO-PO-PSO MAPPING:

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	–	1	3	2	1	2	2	2	2
CO2	1	2	1	1	3	3	1	2	1	2	2

CO3	2	3	2	2	2	2	–	2	2	2	3
CO4	2	2	2	2	3	2	1	2	2	2	3
CO5	1	1	2	–	3	3	2	2	1	2	2
CO6	1	2	2	1	2	3	2	2	1	2	2

‘3’ – Strongly correlated; ‘2’ – Moderately correlated; ‘1’ – Slightly correlated; ‘ - ’ Not applicable