



**TECHNO INDIA UNIVERSITY**  
WEST BENGAL

## **Syllabus 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 :**

**M.Sc in Microbiology**

**Semester II**

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1	TIU-PMB-T112	Basic of Pathology	2	1	0	3	
2	TIU-PMB-T114	Environment and Food Microbiology	2	1	0	3	
3	TIU-PMB-T122	Biological evolution	2	1	0	3	
4	TIU-PMB-T118	Pharmacology and Bioethics	2	1	0	3	
5	TIU-PMB-T120	Biostatistics Computer and Bioinformatics	2	1	0	3	
6	TIU-PMB-S100	CASD (Communicative English)	2	1	0	3	
<b>Practical</b>							
1	TIU-PMB-L112	Pathology Lab	0	0	2	2	
2	TIU-PMB-L114	Environmental and Food Microbiology Lab	0	0	2	2	
3	TIU-PMB-S122	Training and Seminar Presentation	0	0	2	2	
4	TIU-PES-S198	Entrepreneurship Skill Development (ESD)	0	0	2	2	
<b>Total Credit</b>						26	



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**Department of Microbiology**  
**Techno India University, West Bengal**

**Semester II**

**Course Name:** Basic of Pathology (Theory)

**Course Code:** TIU-PMB-T112

**Course outcome:**

- Demonstrate an understanding of the principles of pathological study and the roles of bacteria, viruses, fungi, and parasites in human health and disease.
- Describe the structure and function of bacterial cells, viruses, fungi, and parasites.
- Identify and discuss the laboratory techniques used to detect and identify microbial organisms.
- Discuss the principles of immunology and the roles of the human immune system in host defense.
- Describe the roles of antimicrobial agents in the prevention, diagnosis, and treatment of infectious diseases.
- Analyze the factors that influence the epidemiology of infectious diseases.
- Discuss the principles of public health and the role of medical microbiology in improving public health.
- Demonstrate the ability to interpret results from microbiological experiments and apply the results to medical and public health situations.
- Utilize appropriate safety procedures in the laboratory and the medical setting.

**Course Contents:**

- Normal flora of human body, Bacterial toxins, toxicity and pathogenesis
- Antibacterial substances and drug resistance: Control of bacterial growth - physical and chemical agents, preservation methods, stress responses.
- 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
- Plant pathology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
- Basic hematology, laboratory organization and safety measures and waste management. Anticoagulants, sample collection techniques, preservation, transport and handling
- Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.



**Reference books:**

- Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
- Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
- Janeway et al., Immunobiology, 4th Edition, Current Biology publications, 1999.
- Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
- Walker J.M. and Gingold, E.B. (1983) Molecular Biology and Biotechnology (Indian Edition) Royal Society of Chemistry U.K

**Course Name:** Environment and Food Microbiology (Theory)

**Course Code:** TIU-PMB-T114

**Course outcome:**

- Understand the different types of microorganisms along with their habitat and to understand about extremophiles.
- Understand the microbe interactions and to learn about different microbe-Plant interactions.
- Understand the different biogeochemical and nutrient cycles.
- Understand the management of different types of solid waste and to understand the sewage and its disposal methods.
- Understand the principles and degradation of common pesticides and to understand bioremediation.
- Understand the concept of fermentation and its industrial applications.
- Understand the preservation and maintenance methods of important strains of microbes in dairy microbiology.
- Understand the parameters that affect microbial growth in food, and to learn about food infection and intoxications.
- Understand the principles and methods of food preservation and food sanitation

**Course Contents:**

Gr A

- Environmental complex, interaction of ecological factors: light, temperature, precipitation (rainfall), humidity of air, atmospheric gases and wind; topographical factors; edaphic factors.
- 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.

- Concept of productivity; energy partitioning in food chain and food webs.
- Population properties, density dependent and density independent mechanism of population regulation. Concept of habitat and niche, r and k selection.
- Types of interactions between two species; co-evolution. Biodiversity.
- Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy

### **Gr B**

- 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.
- Microbial food processing: role of indicating microorganisms like lactic acid and other bacteria yeast and molds. Starter cultures.
- Lactic acid, bacteriocins and other metabolites, their applications.
- Fermented food: Production and beneficial effects.
- Food deterioration by mycotoxins. Characteristics of food borne diseases caused by Clostridium, E. coli, Listeria, Salmonella, Shigella,

### **References books:**

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

**Course Name:** Biological evolution (Theory)

**Course Code:** TIU-PMB-T122

### **Course outcome:**

- Understand the different evolutionary processes that shape biodiversity.
- Addresses microevolutionary processes using quantitative genetics at the molecular level.
- In the practical section of the course learn how to use analytical tools to construct and interpret phylogenetic trees from molecular data and understand the evolutionary diversification of gene/protein families.

### **Course Contents:**

- Emergence of evolutionary thoughts



- Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
- 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.
- 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.
- 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.
- 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.

**Course Name:** Pharmacology and Bioethics (Theory)

**Course Code:** TIU-PMB-T118

**Course outcome:**

- Be able to understand various aspects of Good laboratory practices, Good microbiological practices.
- Be able to interpret about culture and microscopic methods including standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods.
- Be able to know about - principles, flow diagrams, limitations of Hazard analysis of critical control point (HACCP).
- To understand the fundamentals of bioethics and ethical issues related to molecular technologies.
- To have the concept on the ethical issues concerned with clinical trials, medical errors, negligence etc.
- To understand the safety issues and ethical use of animals in the laboratory. CO4 To get an insight into the good laboratory practices in different biological laboratories.
- To get an insight into the guidelines and precautions on using radioisotopes in laboratory practices.

**Course Contents:**

Gr A



- 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
- Microbial fermentation and production of small and macro molecules

Gr. B

- 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).
- Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.
- 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.
- 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
- QA and QC in manufacturing and in process of concern companies.
- Concept of Intellectual Property Right and patent formulation. Bioethics

**References books:**

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

**Course Name:** Biostatistics and Bioinformatics (Theory)

**Course Code:** TIU-PMB-T120

**Course outcome:**

- Basic understanding of Moments, Skewness, central tendency kurtosis by moments.
- Well versed in the concepts Probability and Probability Distribution along with its application
- Understand the Statistical Quality Control, Correlation and regression analysis.
- Good understanding and analytical knowledge in applying & testing of Hypothesis and Analysis of variance.



- Basic understanding of Moments, Skewness, central tendency kurtosis by moments. Understanding and remembering about biological databases and its application in various sectors.
- Remembering, understanding and creating sequence alignment by applying appropriate algorithms.
- Creating phylogenetic trees by applying and evaluating suitable methods. 8. Analyze, apply, and create protein structure and perform drug designing.
- Understanding and remembering about biological databases and its application in various sectors.

### **Course Contents:**

#### **Gr.A:**

- Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal);
- Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors;
- Levels of significance; Regression and Correlation; t-test; Analysis of variance; X<sup>2</sup> test;
- Basic introduction to Multivariate statistics, etc

#### **Gr.B: Introduction to bioinformatics.**

- Biological sequence database.
- Sequence comparison, pairwise alignment, multiple alignment.
- Mutation matrix and its application.
- Database searching, algorithms of FASTA and BLAST.
- Basic molecular phylogeny.
- Ligand protein interaction.
- Gene regulatory networks : Dynamic nature of *E. coli* genome, Transcriptional network in *S. cerevisiae*, Mathematical modeling and computer simulation.

### **Reference books:**

- Basotia, G.R. and K.K. Sharma. Research Methodology. Chaudhary, C.H. Research Methodology. RBSA Publications. Daniell, W. Elements of Biostatistics in Health Sciences.
- Singh, S et al. Statistical Methods for Research. Ludhiana: Central Publishing. Enhance, D.N. Fundamentals of Statistics.
- Gupta, S.P. Statistical Methods. New Delhi: S. Chand.



- Khan and Khanna. Fundamentals of Biostatistics. Ukaz Publication Zerold and Jar. Biostatistical Analysis.
- Bioinformatics: Sequence and Genome Analysis, Second Edition (2004) D. Mount, Cold Spring Harbor Laboratory Press, New York.
- Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins, First Edition (1998) A.D. Baxevanis and B.F. Francis Ouellette, John Wiley & Sons, UK.

**Course Name:** CASD

**Course Code:** TIU-PMB-S102

**Course outcome:**

- Develop effective scientific communication skills
- Master the structure and organization of research and review papers
- Convey complex microbiological concepts clearly and concisely
- Acquire proficiency in proper citation methods
- Understand and apply ethical considerations in scientific writing

**Course Contents:**

Unit I

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

Unit II

Semantics: A selected list of Synonyms, Antonyms, Homophones and Homonyms. Form and function of words. Syntax: Sentence structures, Verb patterns and their usage

Unit III

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.

**Course Name:** Pathology Lab

**Course Code:** TIU-PMB-L112

**Course Contents:**

- Determination of MIC
- Determination of MBC and tolerance of an antibacterial agent
- Death kinetic assay
- Disk diffusion assay



- Antagonistic activity of bacteria against fungi by Cross streak method
- Biofilm formation
- Biofilm inhibition by antibiofilm agent

**Course Name:** Environmental and Food Microbiology Lab

**Course Code:** TIU-PMB-L114

**Course Contents:**

- 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).
- Determination of Biochemical Oxygen Demand(BOD)
- Identification of enteric bacilli by IMViC Test
- Isolation of Phosphate solubilising bacteria from soil.
- Isolation of free living Nitrogen fixing bacteria from soil
- Production of vermicompost. Enumeration of microbes and level of N, P, & K before and after composting
- Production and estimation of IAA from microorganism
- Methylene Blue reductase test
- Determination of phosphatase activity of milk.
- Isolation of Lactic acid bacteria(LAB) from milk
- Determination of probiotic activity of LAB: pH tolerance, aggregation, autoaggregation, coaggregation and hydrophobicity
- Preservation of food by using preservative sodium benzoate

**Course Name:** Entrepreneurship Skill Development (ESD)

**Course Code:** TIU-PES-S198

**Course Outcome:**

- Recognize and evaluate potential business opportunities within microbiology, understanding market needs and trends. Master the structure and organization of research and review papers
- Develop comprehensive business plans and effective strategies for launching and sustaining microbiology-based ventures.
- Understand and apply financial principles for budgeting, projection, and management specific to microbiology startups.
- Navigate legal and ethical considerations associated with entrepreneurship in microbiology, including intellectual property and safety regulations.



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- Develop strong communication, networking, and presentation skills to foster innovation, collaboration, and successful business development within the microbiology sector.

**Course Name: Training and Presentation**

**Course Code: TIU-PMB-S122**