TECHNO INDIA UNIVERSITY
WESTBENGAL

Syllabus for 2-year M.Scin Microbiology

Department of Microbiology

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

TECHNO INDIA UNIVERSITY
WESTBENGAL

Course Curriculum For All Semester ;

M.Sc in Microbiology

Semester I

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
Theory							
1	TIU-PMB-T101	General Microbiology	2	1	0	3	
2	TIU-PMB-T113	Bacterial physiology	2	1	0	3	
3	TIU-PMB-T115	Phycology, Mycology and Virology	2	1	0	3	
4	TIU-PMB-T107	Biochemistry	2	1	0	3	
5	TIU-PMB-T109	Biophysics and Instrumentation	2	1	0	3	
6	TIU-PEN-T101	Career Advancement Skill Development (CASD)	2	1	0	3	
Practical							
1	TIU-PMB-L101	General Microbiology Lab	0	0	2	2	
2	TIU-PMB-L107	Biochemistry Lab	0	0	2	2	
3	TIU-PMB-L109	Biophysics and Instrumentation Lab	0	0	2	2	
4	TIU-PES-S197	Entrepreneurship Skill Development (ESD)	0	0	2	2	
Total Credit						26	

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Department of Microbiology
Techno India University, West Bengal

Semester I

Course Name: General Microbiology (Theory)
Course Code: TIU-PMB-T101
Course Outcome:

- Demonstrate a basic understanding of microbial taxonomy, physiology, and ecology.
- Recognize the importance of microbes in the environment, in industry, and in human health.
- Describe the methods used to study microbes in the laboratory.
- Explain the principles of microbial growth, enumeration, and control.
- Develop an appreciation of microbial diversity and the roles of microbes in global ecology and biotechnology.
- Identify and describe the major microbial diseases affecting humans and animals.
- Design and implement experiments to study the growth and activities of microbes.
- Describe the role of antibiotics in the treatment of microbial diseases.
- Discuss the impact of human activities on the environment and microbial populations.
- Demonstrate an understanding of the nature of scientific inquiry, data analysis, and communication

Course Contents:

- History of microbiology.
- Nomenclature and classification of microorganisms. General account of Cyanobacteria
- Extremophile: anaerobes, halophiles, acidophile, alkalophile, tharmophile, barophile; Community structure and organization. Effect of heavy metal and xenobiotic substances on microbes; biological magnification of toxic substances.
- Aeromicrobiology: Microbes of indoor and outdoor environment, pathways, enumeration, Extramural and intramural, control, bioterrorism. Eutrophication, Biosafety.
- Water microbiology: Significance of microbes in water quality. Test for portability of water. Microbial treatment of sewage; application of wastewater in land; composting of biosolids and domestic solid waste.
- Marine microbes and their applications.
- Microorganism and metal pollutants; biodegradation of TNT, PCB; Bioremediation: bioventing, biofiltration, bioaugmentation, problems andadvantages.

- Bioleaching: mineral extraction, oil recovery.

Reference Books:

- Topley and Wilson's Principles of Bacteriology; Virology; and Immunity
- Graham Wilson, Williams & Wilkins, 7th edition (December 1983) Pelzer Microbiology
- Prescott Microbiology

Course Name: Bacterial physiology (Theory)
Course Code: TIU-PMB-T113
Course Outcome:

- Identify and classify bacteria based on their morphology, physiology, and biochemical characteristics.
- Analyze and interpret the results of laboratory tests used to diagnose bacterial infections.
- Understand the epidemiology of infectious diseases and the role of bacteria in them.
- Select and perform appropriate laboratory tests to identify and characterize bacterial pathogens.
- Understand the principles of antimicrobial chemotherapy and the mechanisms of antimicrobial resistance.
- Utilize appropriate quality control procedures and safety protocols in the laboratory setting.
- Comprehend the principles of immunology and the role of antibodies in the diagnosis and treatment of bacterial infections.
- Demonstrate knowledge of the principles of bioinformatics and genomics in the identification of pathogenic and non-pathogenic bacteria.

Course Contents:

- Characterization of bacteria: (i) morphological: shape, Gram stain, endo-spore stain, capsule stain, acid-fast stain, flagella stain; (ii) cultural: growth in different carbon sources (media); (iii) biochemical test: catalase, peroxidase, nitrate reduction, fermentation of sugar.
- Cultivation of bacteria: aerobic, anaerobic, and facultative. Pure culture and its characteristics. Nutritional types. Enrichment culture technique for specific bacterial types: endospore forming, nitrogen fixing, nitrifying, starch degrading, cellulose degrading, casein degrading, phosphate solubilizing. Unculturable and culturable bacteria- conventional, metagenomic approaches.
- Strategies of cell division, growth kinetics, generation time, asynchronous, synchronous, batch, continuous culture, measurement of growth, and factors affecting growth. Mechanism of cell division.

- Ultra-structure of bacteria: cytoplasmic and outer membrane, capsule, flagella, pilli, endospore, and special organelle. Gram-negative, Gram-positive, and acid-fast bacteria. Wall-deficient organisms, including L-form,.
- Cell wall synthesis, flagellar synthesis.

Reference Books:

- Topley and Wilson's Principles of Bacteriology; Virology; and Immunity
- Graham Wilson, Williams & Wilkins, 7th edition (December 1983) Pelzer Microbiology
- Prescott Microbiology

Course Name: Phycology, Mycology and Virology (Theory)
Course Code:TIU-PMB-T115
Course Outcome:

- Explain the basic concepts of phycology, mycology and virology, including the structure, classification, and life cycle of algae, fungi and viruses.
- Identify different types of algae, fungi, viruses and understand their role in ecosystems.
- Describe the ecological relationships between algae, fungi, viruses and other organisms, including their role in the food web.
- Outline the medical and economic importance of algae, fungi and viruses.
- Discuss the methods used in the identification and cultivation of algae, fungi and viruses.
- Investigate genetics of algae, fungi and viruses and the potential applications of this knowledge.
- Analyze the impact of human activities on algae, fungi and virus and their environment.
- Develop strategies for the conservation and management of algae, fungi and virus resources.

Course Contents:

- General account of algae, types of algae, Beneficial role of algae and pathologically important algae in bacteria, plant and animal, Anti algal agent.
- General account of fungi, types of fungi, beneficial role of fungi and pathologically important fungi in bacteria, plant and animal, Antifungal agent
- General account of Virus, types of Virus, Beneficial role of Virus-Phage Therapy and pathologically important virus in bacteria, plant and animal, Antiviral agent
- Special microorganism: Mycorrhiza, Lichen, Virion, Viroid, prion

Reference Books:

- Arora, D.R. and Brij Bala Arora. Medical Mycology. New Delhi: CBS Publishers, 2013.
- Alexopolous, J. and W. M. Charles. 1988. Introduction to Mycology. Wiley Eastern,New Delhi.
- Mckane, L. and K. Judy.1996. Microbiology–Essentials and Applications. McGraw Hill,NewYork.
- Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
- Pandey, B. P.2007. Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics. S. Chand & Company Ltd, New Delhi.
- Sambamurthy, A. V. S. S.2006. A Textbook of Plant Pathology. I.K. International Pvt. Ltd., New Delhi.
- Sambamurthy, A. V. S. S.2006. A Textbook of Algae. I. K. International Pvt. Ltd., New Delhi. Sharma, O. P.1992. Textbook of Thallophyta. McGraw Hill Publihing Co., New Delhi.

Course Name: Biochemistry (Theory)
Course Code:TIU-PMB-T107
Course outcome

- Understand the structure and function of the major classes of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids.
- Analyze the chemical and physical properties of biomolecules and the energetics of biochemical reactions.
- Describe the role of enzymes and other proteins in the regulation of biochemical pathways.
- Understand the principles and techniques used to analyze biomolecules and biochemical pathways.
- Explain the biochemical basis of human nutrition, metabolism, and disease.
- Develop a working knowledge of genetic engineering, biotechnology, and other applications of biochemistry.
- Design and carry out experiments to test hypotheses related to biochemistry.

Course Contents:

- Structure of atoms, molecules and chemical bonds.
- Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
- Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).

- Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
- Bioenergetics, glycolysis, TCA, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

Reference books

- Cell (A Molecular approach): Cooper, G. M.
- Cell and Molecular Biology (1996) Karp, G.
- Cell and Molecular Biology: deRobertis and deRobertis
- Principle of Biochemistry: Leninger , A. L.
- Biochemistry (1995) Lubert Stryer

Course Name: Biophysics and Instrumentation (Theory)

Course Code:TIU-PMB-T109

Course outcome

- Develop an understanding of the physical principles that govern the behavior of biological systems.
- Interpret and analyze experimental results in the context of physical principles.
- Use mathematical models to predict and explain the behavior of biological systems.
- Design experiments to test hypotheses about biological systems.
- Employ quantitative techniques to study biological systems.
- Apply biophysical principles to solve problems in medicine, biology and biotechnology.
- Communicate scientific concepts and results to a variety of audiences.

Course Contents:

- Microscopy: Principle and applications of light, phase contrast and fluorescence, Electron microscopy -scanning, transmission, confocal, atomic force microscope. Methods of sample processing for EM.
- Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.
- Chromatography- TLC, ion exchange, affinity, reverse phase, gel filtration. Principle and application of High Performance Liquid Chromatography, Fast protein liquid chromatography, ELISA-Reader, Autoanalyzer, FACS,
- Electrophoresis – principle, paper, gel, SDS PAGE.

Reference books:

- Bioanalytical Chemistry (Susan R. Mikkelsen and Eduardo Cortón; Wiley-Interscience; 2004; ISBN 0-471-54447-7
- Biophysical Chemistry- Friedfielder

- Spectrometric Identification of Organic compounds by R M Silverstein and F X Webster; Sixth edition (2002)
- Introduction to Spectroscopy by D Pavia; G Lampman; G Kriz; Second edition (1996)

Course Name: Career Advancement Skill Development (CASD)
Course Code: TIU-PMB-S101
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 Contents:

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: General Microbiology Lab
Course Code: TIU-PMB-L101
Course Contents:

- Preparation of culture media
- Isolation of pure culture by a streak plate preparation
- Isolation of pure culture by a pour plate preparation
- Yeast and mold isolation
- Operation of light microscopy

- Simple staining
- Gram staining
- Isolation of bacteria from water sample by a pour plate technique
- Growth curve of bacteria

Course Name: Biochemistry Lab
Course Code: TIU-PMB-L107
Course Contents:

- Estimation of total carbohydrate, protein of a bacterial cell.
- Estimation of total DNA and RNA of a bacterial cell.
- Coagulase tests, Catalase Tests, Oxidase test, Indole test, Methyl Red test, Urease Test, Biochemical reactions on triple sugar iron agar (TSI).
- Determination of activity of amylase, protease. Effect of pH, temperature on enzyme activity; Enzyme kinetics.
- Determination of MW of protein by PAGE.

Course Name: Biophysics and Instrumentation Lab
Course Code: TIU-PMB-L109
Course Contents:

- Microbiology laboratory rules
- Basic tools in a microbiological laboratory.
- Basic equipments in laboratory
- Microscopy: Light microscopy, Phase contrast microscopy, Fluorescence microscopy
- Laminar air flow, Autoclave, Hot air oven.
- Incubator, Orbital shaking incubator,Water bath
- Weighing balance, Ph meter, Centrifuge machine, Distillation apparatus.
- Spectrophotometer
- Agarose gel electrophoresis, Uv-transilluminator
- Polyacrylamide gel electrophoresis (PAGE) and Gel documentation System
- Sonicator

Course Name: Entrepreneurship Skill Development (ESD)
Course Code: TIU-PES-S197
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.
- Develop strong communication, networking, and presentation skills to foster innovation, collaboration, and successful business development within the microbiology sector.