



**2-Year Master of Science (M.Sc.) Curriculum and
Syllabus for Microbiology
Second Semester**

Course code	Course Name	L	P	T	Credits
TIU-PMB-T112	Basic of Pathology	3	0	0	3
TIU-PMB-T114	Environment and Food Microbiology	3	0	0	3
TIU-PMB-T122	Biological evolution	3	0	0	3
TIU-PMB-T118	Pharmacology and Bioethics	3	0	0	3
TIU-PMB-T120	Biostatistics and Bioinformatics	3	0	0	3
TIU-PMB-S102	CASD-Seminar presentation-Review paper	0	3	0	3
TIU-PMB-L112	Pathology Lab	0	2	0	2
TIU-PMB-L114	Environmental and Food Microbiology Lab	0	2	0	2
TIU-PMB-S122	Training and seminar presentation	0	2	0	2
TIU-PES-S198	ESD	0	2	0	2
	Total Credits	15	11	0	23



Semester II

TIU-PMB-T112	Basic of Pathology
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1. Normal flora of human body, Bacterial toxins, toxicity and pathogenesis
2. Antibacterial substances and drug resistance: Control of bacterial growth - physical and chemical agents, preservation methods, stress responses.
3. 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
4. Plant pathology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
5. Basic hematology, laboratory organization and safety measures and waste management. Anticoagulants, sample collection techniques, preservation, transport and handling
6. 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.
- Paul, 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



TIU-PMB-T114	Environment and Food Microbiology
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Gr A

1. 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.
2. Energy flow through ecosystem, energy environment. Concept of productivity; energy partitioning in food chain and food webs;
3. Population properties, density dependent and density independent mechanism of population regulation. Concept of habitat and niche, r and k selection.
4. Types of interactions between two species; co-evolution. Biodiversity.
5. Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy

Gr B

1. Microorganisms associated with food (milk, meat, fish, cereals, vegetables and fruits).
2. Spoilage of foods, maintenance of food sterility and preservatives.
3. Food preservation methods: physical, synthetic, natural and biological.
4. Microbial food processing: role of indicating microorganisms like lactic acid and other bacteria yeast and molds. Starter cultures.
5. Lactic acid, bacteriocins and other metabolites, their applications.
6. Fermented food: Production and beneficial effects.
7. 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.



TIU-PMB-T122	Biological evolution
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1. Emergence of evolutionary thoughts
2. Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
3. 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.
4. 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.
5. 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.
6. 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.

TIU-PMB-T118	Pharmacology and Bioethics
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Gr A

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

Gr. B

1. Animal & human ethics involved in microbiological work



2. 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).
3. Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.
4. Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory) Safety in microbiology laboratory.
5. Current and future implications concerning food safety, hazards and risks.
6. 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
7. QA and QC in manufacturing and in process of concern companies.
8. 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 sangram keshari mohanty.

TIU-PMB-T120	Biostatistics and Bioinformatics
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Gr.A:

1. Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal);
2. Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors;
3. Levels of significance; Regression and Correlation; t-test; Analysis of variance; X² test;
4. Basic introduction to Multivariate statistics, etc.



Gr.B: Introduction to bioinformatics.

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

1. 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.



TIU-PMB-L112	Pathology Lab
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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

TIU-PMB-L114	Environmental and Food Microbiology Lab
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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

TIU-PES-S198	ESD
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TIU-PMB-S122	Training and seminar presentation
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